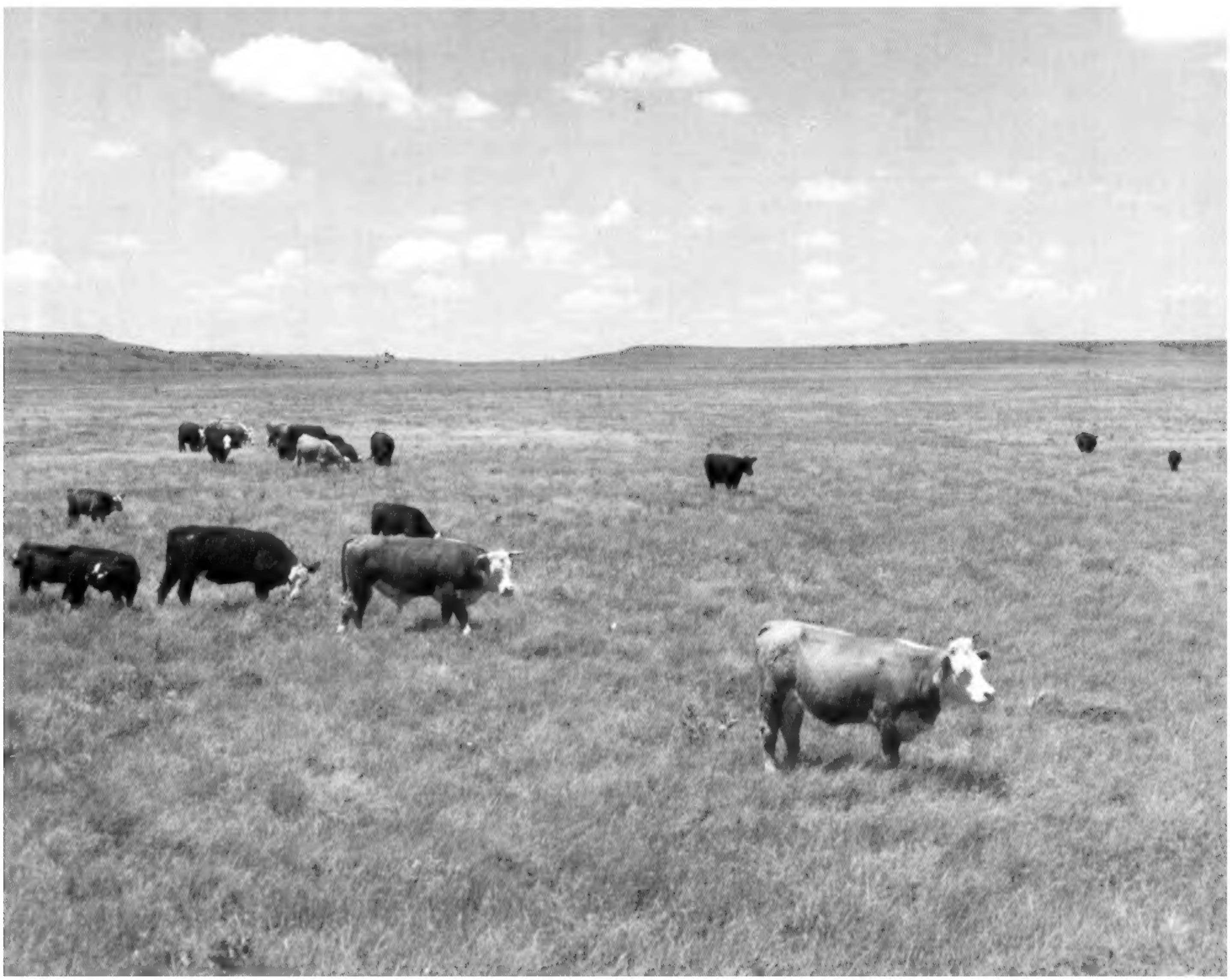
United States
Department of
Agriculture

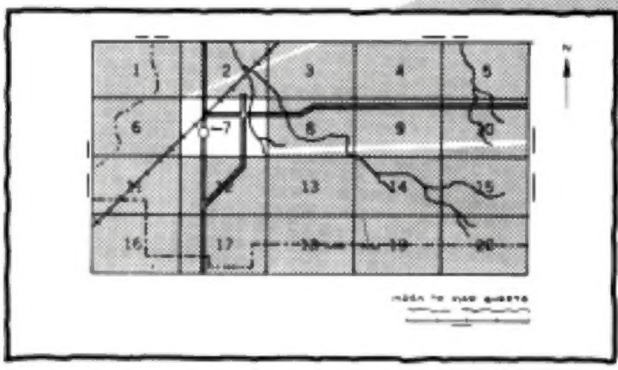
Soil
Conservation
Service

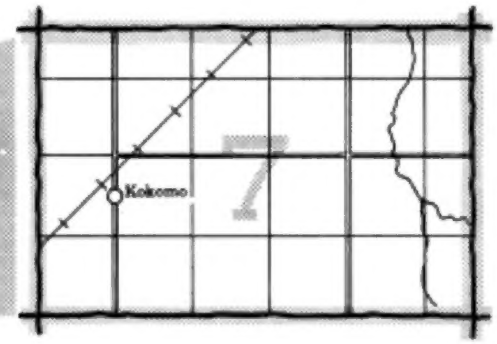
Soil Survey of Elk County, Kansas



HOW TO USE

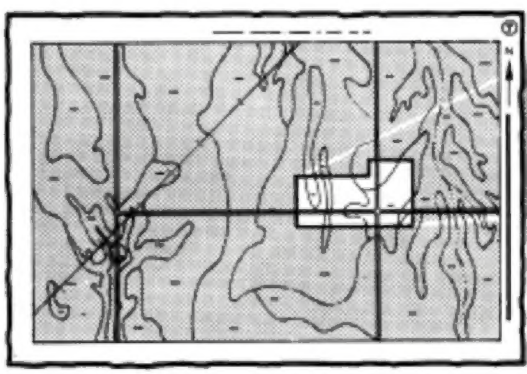
1. Locate your area of interest on the "Index to Map Sheets"

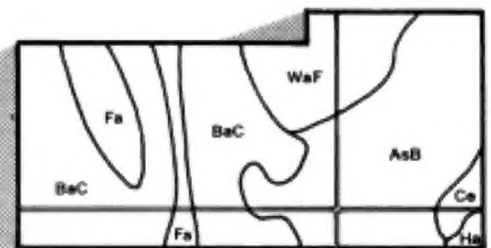




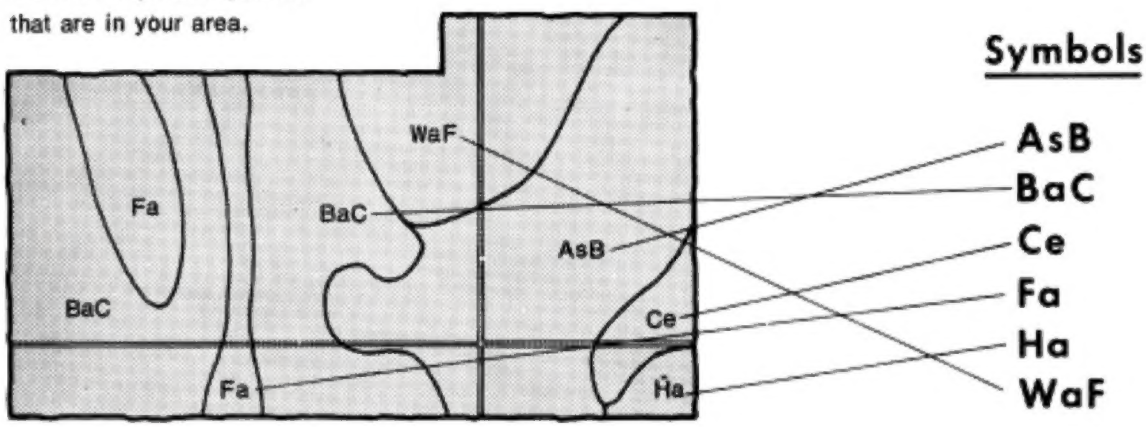
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



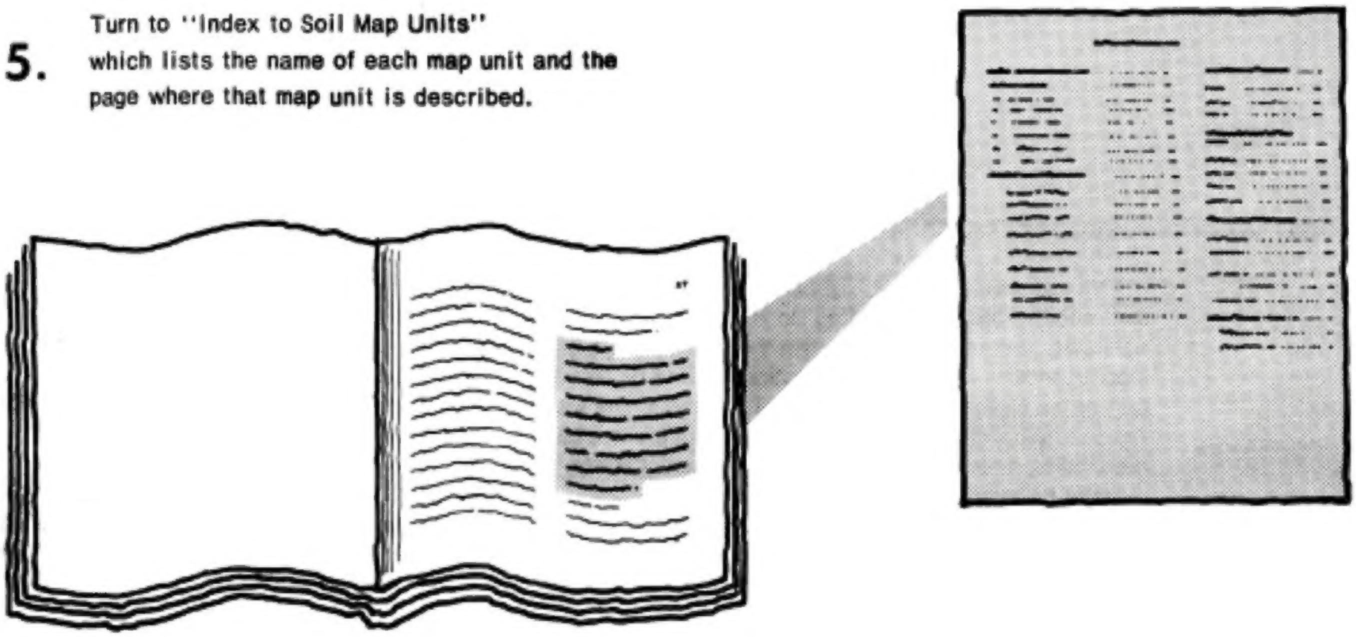


4. List the map unit symbols that are in your area.

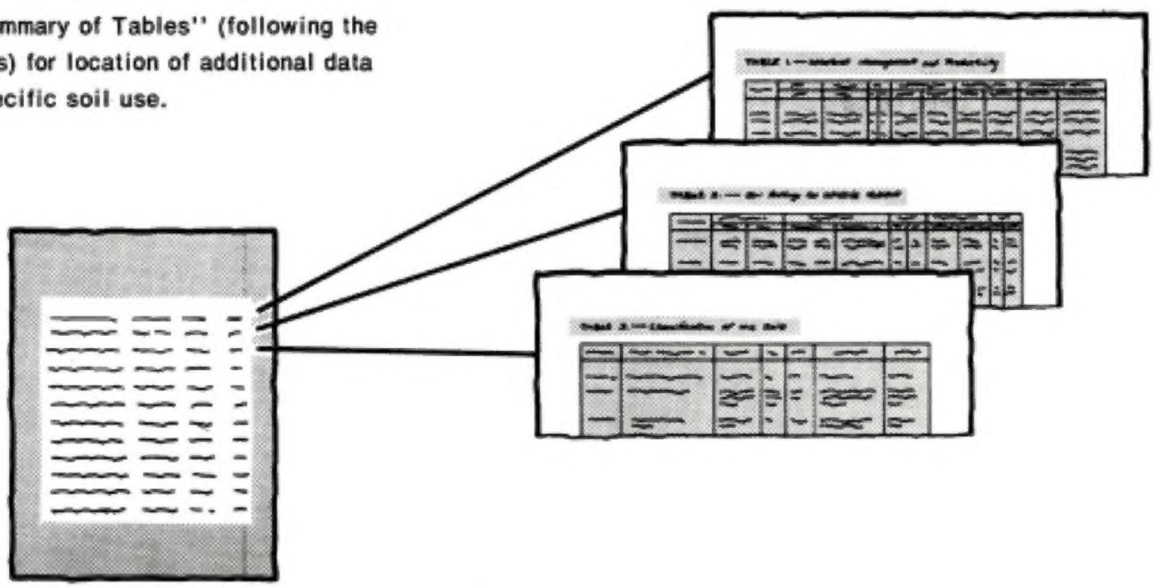


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1983. Soil names and descriptions were approved in 1983. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1983. This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Elk County Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Good stand of native grasses in an area of Labette and Sogn soils.

Contents

Soil Series

Issued November 1986

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Elk County, Kansas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

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Soil Survey of
Elk County, Kansas

By Jim R. Fortner, Elbert L. Bell, and Paul R. Kutnink,
Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
the Kansas Agricultural Experiment Station

General Nature of the County

ELK COUNTY is in the southeastern part of Kansas (fig. 1). It has an area of 416,333 acres, or about 650 square miles. In 1982, it had a population of 3,541. Howard, the county seat and the largest town, had a population of 891.

Most of Elk County is in the Bluestem Hills major land resource area. The eastern third, however, is in the Cross Timbers major land resource area. The soils in the county are generally deep or moderately deep, are gently sloping to strongly sloping, and have a clayey subsoil. Elevation ranges from about 840 to 1,640 feet above sea level.

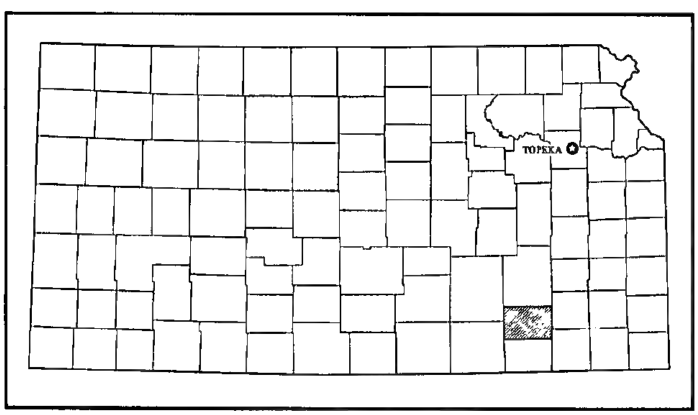


Figure 1.—Location of Elk County in Kansas.

Most of Elk County is drained by the Elk River and its tributaries, which flow in a southeastern direction across the county (fig. 2). The southwest corner of the county is drained by the Caney River and the northeast corner by the Fall River. Many lakes have been built in the watersheds of the Elk and Caney Rivers.

Farming, ranching, oil production, and services related to these activities are the main enterprises in the county. About 70 percent of the county is rangeland or pasture, 19 percent is cropland, 6 percent is woodland, and 5 percent consists of farmsteads, roads, and urban and other areas (*6*). Grain sorghum, wheat, soybeans, and hay are the principal crops.

Climate

Prepared by Merle J. Brown, climatologist, Kansas Agricultural Experiment Station, Manhattan, Kansas.

The climate in Elk County is typical continental, as can be expected of a location in the interior of a large landmass in the middle latitudes. This climate is characterized by large daily and annual variations in temperature. Winters are cold because of frequent outbreaks of polar air. The cold temperatures prevail from December to February. Warm summer temperatures prevail for about 6 months every year. They provide a long growing season for the crops in the county. Spring and fall are relatively short.

Elk County is in the path of a fairly dependable current

of moisture-laden air from the Gulf of Mexico. Precipitation is heaviest late in spring and early in summer. Much of it falls during late-evening or nighttime thunderstorms. Although the total precipitation generally is adequate for any crop, its distribution may cause problems in some years. Dry periods of several weeks are not uncommon during the growing season. A surplus of precipitation often results in muddy fields, which delay planting and harvesting.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Howard in the period 1951 to 1976. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 35.1 degrees F, and the average daily minimum temperature is 23.2 degrees. The lowest temperature on record, which occurred at Grenola on February 13, 1905, is -23 degrees. In summer the average temperature is 77.7 degrees, and the average daily maximum temperature is 90.2 degrees. The highest recorded temperature, which occurred at Howard on July 14, 1954, is 115 degrees.

The total annual precipitation is 36.05 inches. Of this, 25.01 inches, or about 69 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 17.35 inches. The heaviest 1-day rainfall during the period of record was 11.40 inches at Howard on July 3, 1976.

The average seasonal snowfall is 13.7 inches. On the average, 13 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The sun shines 70 percent of the time possible in summer and 57 percent in winter. The prevailing wind is from the south. Average windspeed is 11 miles per hour. It is highest in March and April.

Tornadoes and severe thunderstorms strike occasionally. These storms are usually local in extent and of short duration, so that the risk of damage is small. Hail falls during warm periods. The hailstorms are infrequent, however, and are of local extent. They cause less crop damage in this county than in western Kansas.

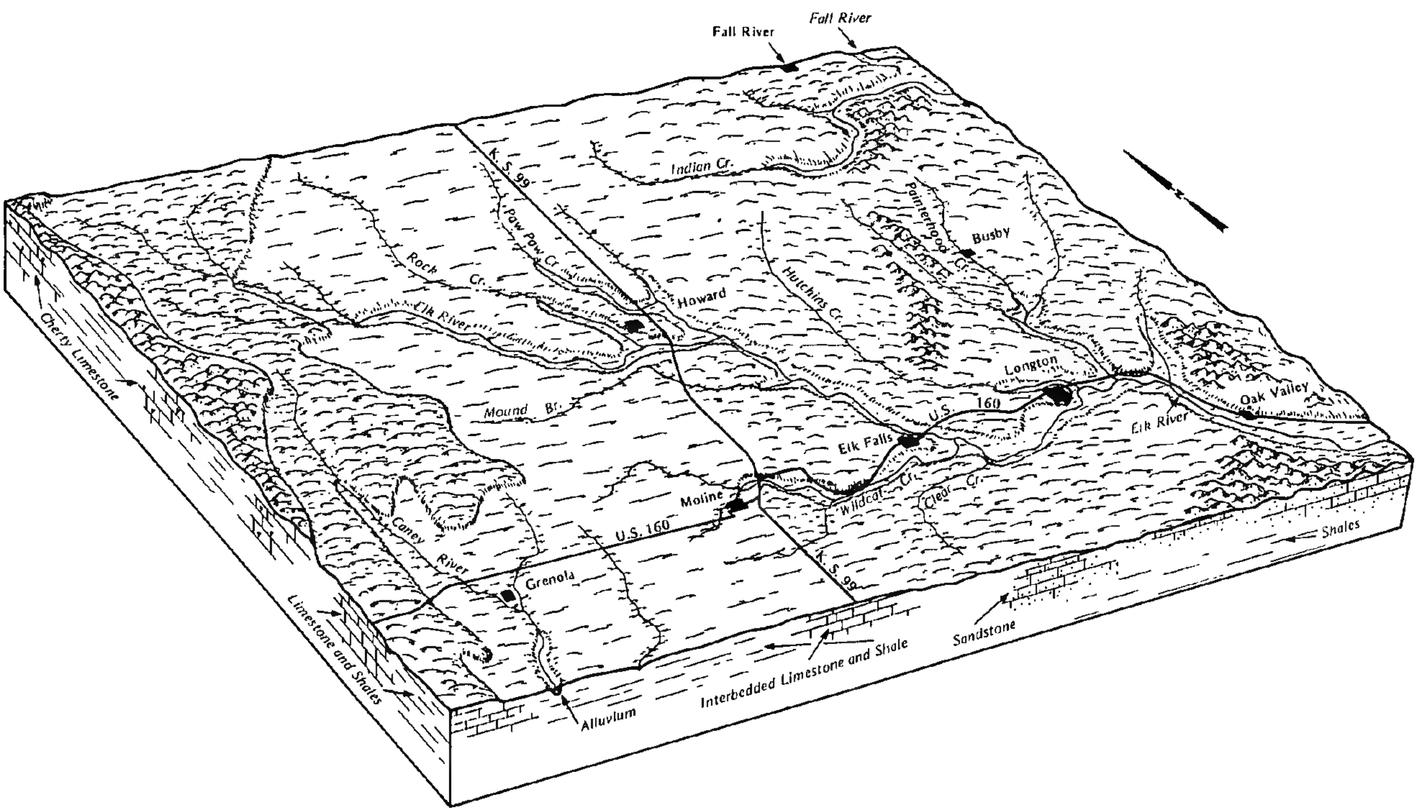


Figure 2.—Drainage pattern, relief, and geology in Elk County.

Natural Resources

Soil is the most important natural resource in the county. It provides a growing medium for range plants and field crops.

Other natural resources include oil, limestone, and water. The limestone is quarried for use as road material, concrete aggregate, and agricultural lime. One of the largest limestone quarries in this section of the United States is near Moline, in the southern part of the county. Some limestone is sold locally, but much is shipped by railroad and trucks to other parts of the state and the Nation. Oil production is widespread. In 1981, the county produced about 300,000 barrels of oil. The water supply comes mainly from surface impoundments and streams (fig. 3). Many ponds and watershed lakes have been built throughout the county.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area

Figure 3.—A stream used as a source of water for domestic purposes in Elk County.

dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

Map Unit Descriptions

This section describes the map units in the survey area at two levels of detail. The general soil map units, called soil associations, are described first and then the detailed map units. The general soil map units generally represent the soils of major extent in the survey area. The detailed map units represent all of the named soils in the survey area.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The descriptions and names of the soils identified on the general soil map of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications of series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

1. Niotaze-Darnell-Stephenville Association

Moderately deep and shallow, gently sloping to steep, somewhat poorly drained and well drained soils that have a clayey or loamy subsoil; on uplands

This association is on narrow ridgetops and side slopes. Intermittent drainageways are common. In places stones and boulders are on the surface. Slopes range from 1 to 35 percent.

This association makes up about 5 percent of the county. It is about 26 percent Niotaze soils, 24 percent Darnell soils, 24 percent Stephenville soils, and 26 percent minor soils (fig. 4).

The moderately deep, somewhat poorly drained Niotaze soils formed in material weathered from shale interbedded with sandstone. These moderately sloping to steep soils are on narrow ridgetops and side slopes. Typically, the surface layer is very dark grayish brown cobbly fine sandy loam about 3 inches thick. The subsurface layer is pale brown, mottled fine sandy loam about 4 inches thick. The subsoil is about 23 inches thick. The upper part is strong brown, firm silty clay. The next part is light olive brown, mottled, very firm silty clay. The lower part is grayish brown, mottled, very firm clay. Clayey shale bedrock is at a depth of about 30 inches.

The shallow, well drained Darnell soils formed in sandstone residuum. These gently sloping to steep soils are on ridgetops and side slopes. Typically, the surface layer is very dark grayish brown fine sandy loam about 4 inches thick. The subsoil is dark yellowish brown, very friable gravelly fine sandy loam about 8 inches thick. Sandstone bedrock is at a depth of about 12 inches.

The moderately deep, well drained Stephenville soils formed in sandstone residuum. These gently sloping and moderately sloping soils are on ridgetops. Typically, the surface layer is dark brown fine sandy loam about 6 inches thick. The subsurface layer is dark yellowish brown fine sandy loam about 5 inches thick. The subsoil is yellowish red, firm sandy clay loam about 21 inches thick. It is mottled in the lower part. Sandstone bedrock is at a depth of about 32 inches.

Minor in this association are Prue, Steedman, and Verdigris soils and numerous sandstone outcrops. The deep Prue soils are on foot slopes. The moderately well drained Steedman soils are on ridgetops and side slopes. The deep, silty Verdigris soils are on flood plains along drainageways.

This association is used mainly as range. Some areas along the foot slopes and drainageways are used for cultivated crops. Much of the acreage is covered with blackjack oak and post oak. The main concerns in managing range are controlling excess brush and maintaining a vigorous stand of desirable grasses.

2. Steedman-Dennis-Eram Association

Moderately deep and deep, gently sloping to strongly sloping, moderately well drained soils that have a dominantly clayey subsoil; on uplands

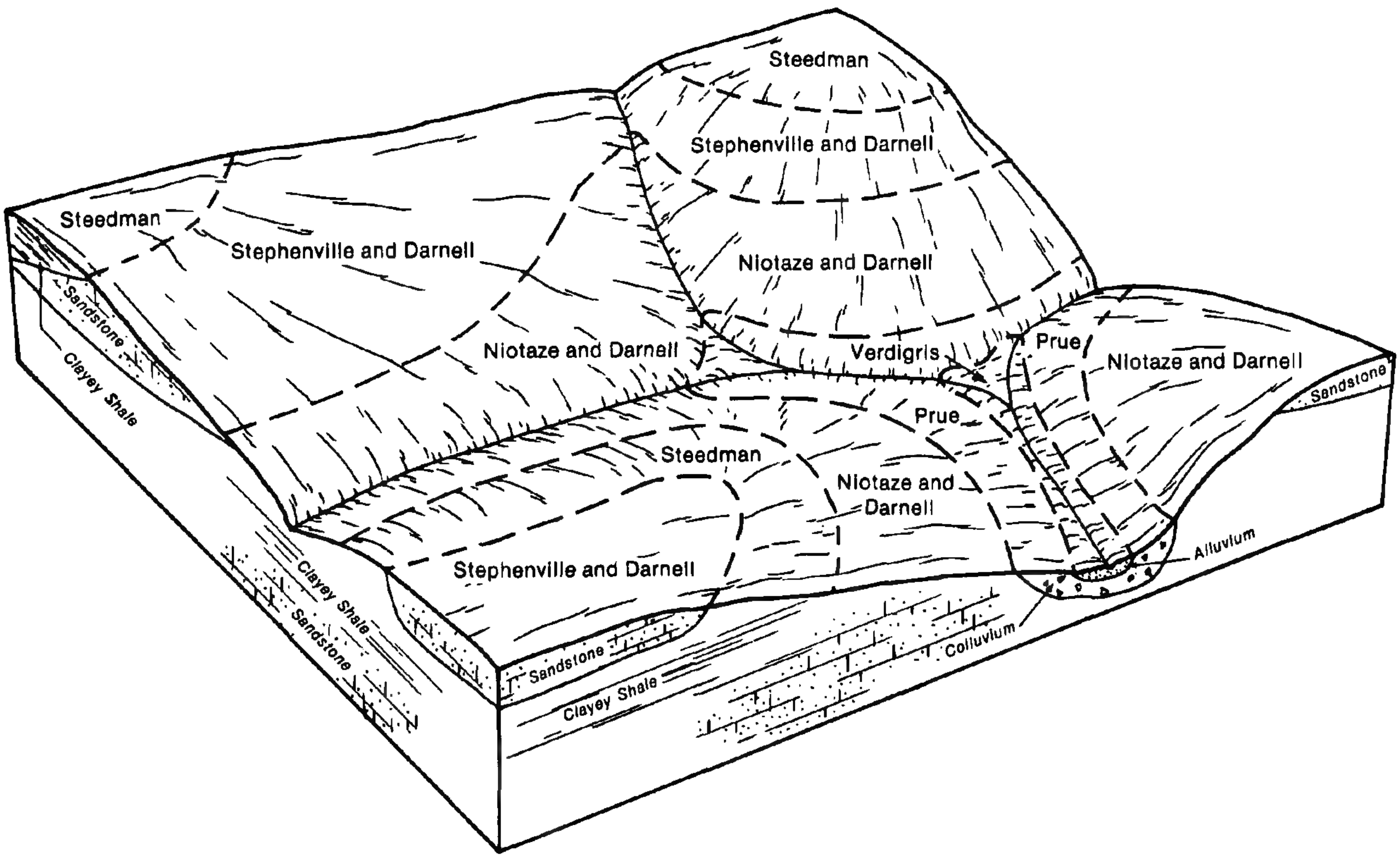


Figure 4.—Typical pattern of soils and underlying material in the Niotaze-Darnell-Stephenville association.

This association is on convex ridgetops and side slopes that are dissected by intermittent drainageways. Slopes range from 1 to 20 percent.

This association makes up about 25 percent of the county. It is about 48 percent Steedman soils, 13 percent Dennis soils, 10 percent Eram soils, and 29 percent minor soils (fig. 5).

The moderately deep Steedman soils formed in shale residuum. These moderately sloping and strongly sloping soils are on ridgetops and side slopes. Typically, the surface layer is very dark grayish brown stony loam about 7 inches thick. The subsoil is silty clay about 29 inches thick. The upper part is dark brown, mottled, and firm; the next part is brown, mottled, and very firm; and the lower part is grayish brown and light olive brown and is very firm. Clayey shale bedrock is at a depth of about 36 inches.

The deep Dennis soils formed in shale residuum. These gently sloping and moderately sloping soils are on side slopes or foot slopes. Typically, the surface layer is very dark brown silt loam about 13 inches thick. The subsoil extends to a depth of more than 60 inches. The upper part is dark brown, mottled, friable silty clay loam; the next part is brown and dark yellowish brown, mottled, very firm silty clay; and the lower part is strong brown, mottled, extremely firm silty clay.

The moderately deep Eram soils formed in shale residuum. These gently sloping and moderately sloping soils are on ridgetops and side slopes. Typically, the surface layer is very dark grayish brown silt loam about 10 inches thick. The subsoil is about 23 inches thick. The upper part is dark brown, firm silty clay loam, and the lower part is grayish brown, mottled, firm and very firm silty clay. Shale bedrock is at a depth of about 33 inches.

The minor soils in this association are the Clime, Darnell, Niotaze, Sogn, and Stephenville soils. The calcareous Clime soils are on side slopes. The somewhat poorly drained Niotaze soils are on ridgetops and side slopes. The well drained Stephenville soils and the shallow Darnell and Sogn soils are on ridgetops.

This association is used mostly as range. Some areas on ridgetops and foot slopes are used for hay or

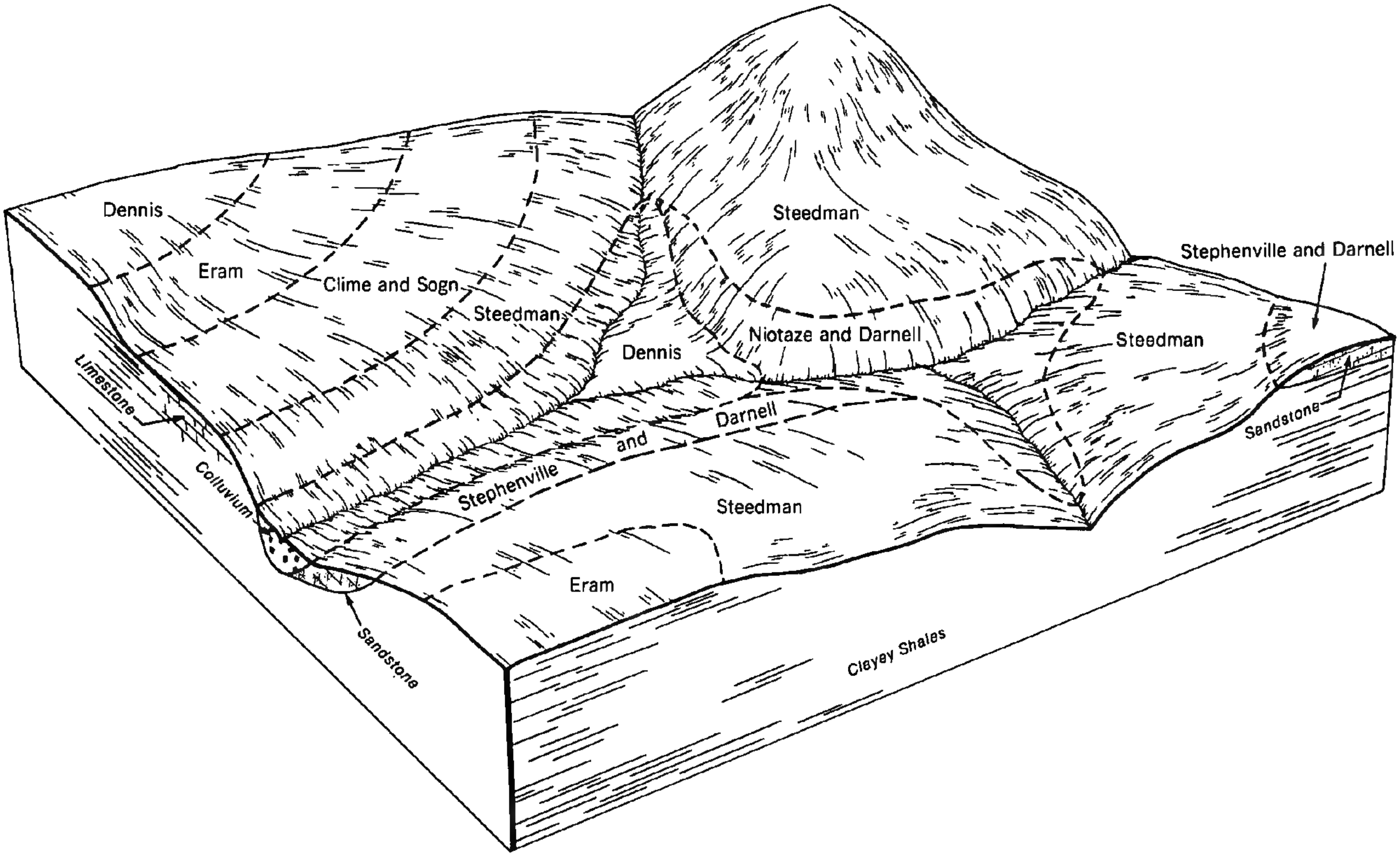


Figure 5.—Typical pattern of soils and underlying material in the Steedman-Dennis-Eram association.

cultivated crops. The main concern in managing range is maintaining a vigorous stand of desirable grasses.

3. Florence-Martin Association

Deep, gently sloping to strongly sloping, well drained and moderately well drained soils that have a dominantly clayey or cherty clay subsoil; on uplands

The association is in an area called the Flint Hills. It consists of soils on ridgetops and side slopes that are dissected by many drainageways. Slopes range from 1 to 12 percent.

This association makes up about 3 percent of the county. It is about 40 percent Florence soils, 35 percent Martin soils, and 25 percent minor soils (fig. 6).

The well drained Florence soils formed in cherty limestone residuum. These gently sloping to strongly sloping soils are on rounded ridgetops and side slopes. Typically, the surface layer is very dark brown cherty silt loam about 6 inches thick. The subsurface layer is very dark brown very cherty silt loam about 6 inches thick. The subsoil is about 37 inches thick. The upper part is very dark grayish brown, firm extremely cherty silty clay loam. The next part is dark red and dark brown, very firm extremely cherty silty clay. The lower part is dark red, mottled, extremely firm extremely cherty clay. Cherty limestone bedrock is at a depth of about 49 inches.

The moderately well drained Martin soils formed in colluvium or material weathered from shale. These gently sloping to moderately sloping soils are on foot slopes and the lower side slopes. Typically, the surface layer is black silty clay loam about 9 inches thick. The subsoil is silty clay about 46 inches thick. The upper part is very dark gray and firm; the next part is dark grayish brown, mottled, and very firm; and the lower part is grayish brown, mottled, and very firm. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay.

The minor soils in this association are the Clime, Dwight, Ivan, Labette, and Sogn soils. The calcareous Clime soils are on side slopes and foot slopes. The sodium affected Dwight soils are on ridgetops. The calcareous Ivan soils are on narrow flood plains. The moderately deep Labette soils are on ridgetops. The shallow Sogn soils also are on ridgetops.

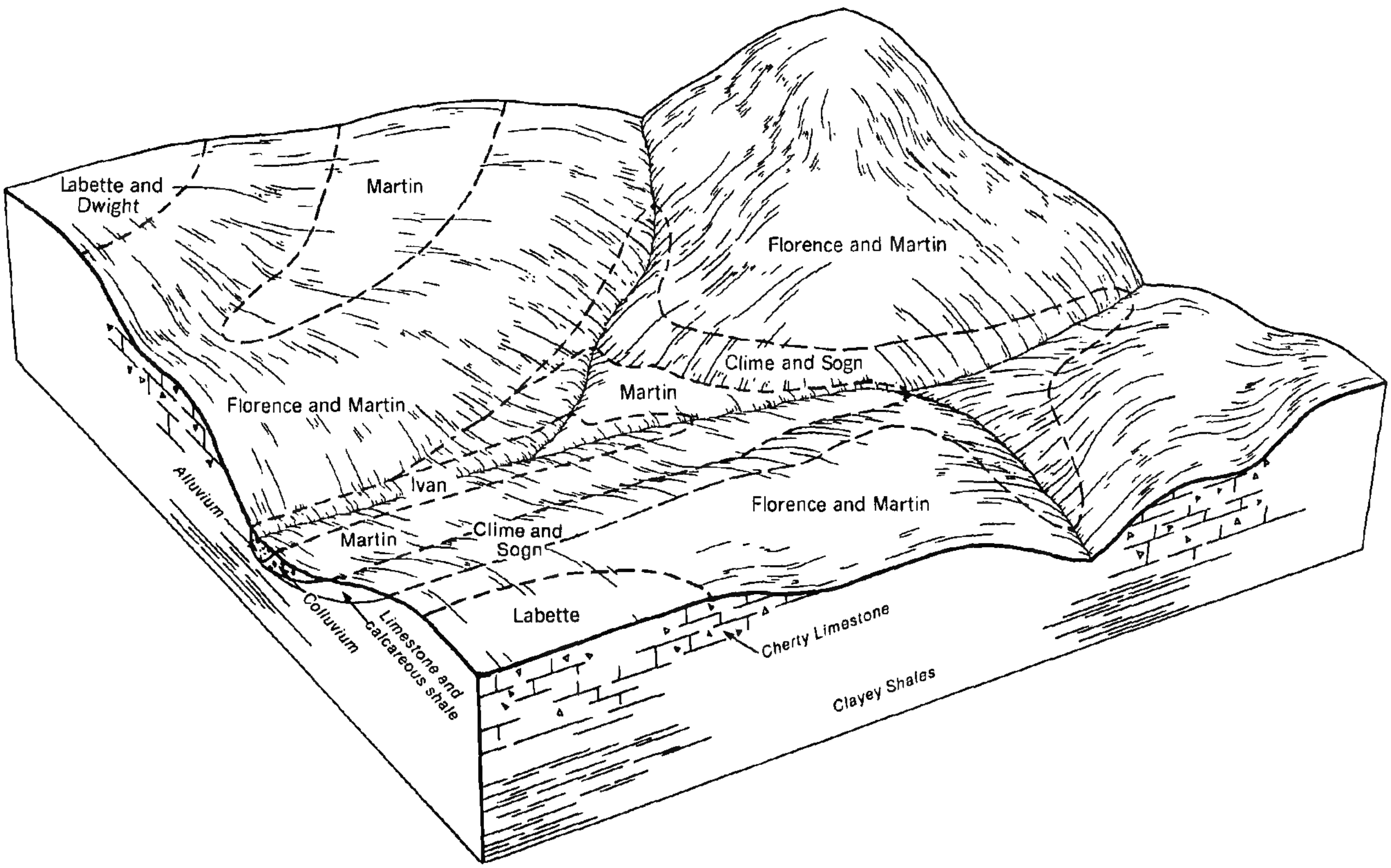


Figure 6.—Typical pattern of soils and underlying material in the Florence-Martin association.

This association is used almost entirely as range. A few areas on foot slopes are used for cultivated crops or hay. The main concern in managing range is maintaining a vigorous stand of native grasses.

4. Mason-Verdigris-Lanton Association

Deep, nearly level, well drained and somewhat poorly drained soils that have a silty subsoil; on stream terraces and flood plains

This association is on bottom land along the major streams in the county. It is subject to flooding. Slopes range from 0 to 2 percent.

This association makes up about 8 percent of the county. It is about 34 percent Mason soils, 33 percent Verdigris soils, 19 percent Lanton soils, and 14 percent minor soils.

The well drained Mason soils formed in silty alluvium on stream terraces. Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer also is very dark grayish brown silt loam about 7 inches thick. The subsoil is firm silty clay loam about 32 inches thick. The upper part is dark brown, and the lower part is brown. The substratum to a depth of about 60 inches is dark yellowish brown, calcareous silty clay loam.

The well drained Verdigris soils formed in silty alluvium on flood plains. Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark brown, friable silt loam about 20 inches thick. The next layer also is dark brown, friable silt loam. It is about 27 inches thick. The substratum to a depth of about 60 inches is dark grayish brown silt loam.

The somewhat poorly drained Lanton soils formed in alluvium on flood plains. Typically, the surface layer is very dark gray silty clay loam about 7 inches thick. The subsurface layer is silty clay loam about 29 inches thick. The upper part is very dark gray, and the lower part is black and mottled. The substratum to a depth of about 60 inches is dark grayish brown, mottled silty clay.

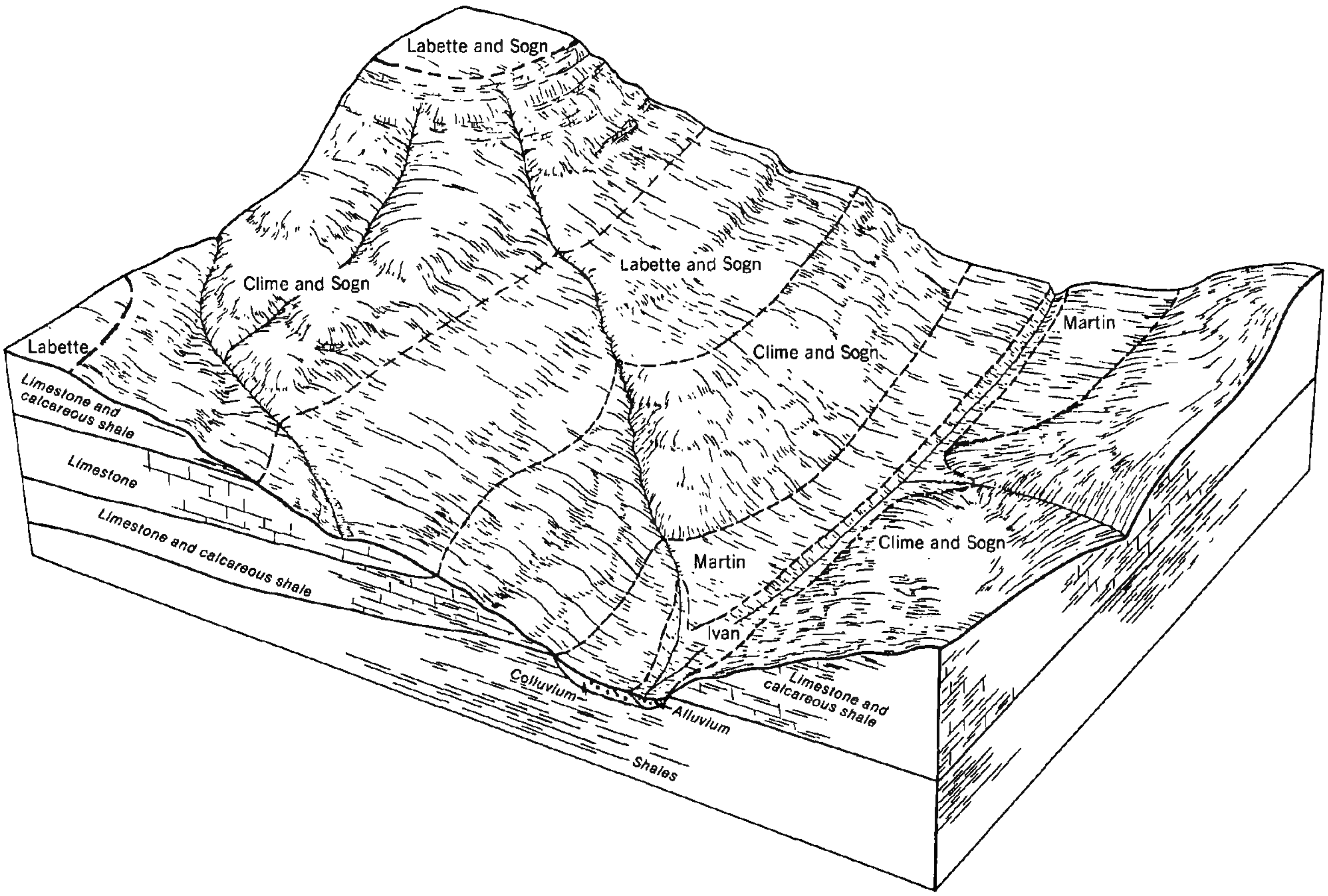


Figure 7.—Typical pattern of soils and underlying material in the Clime-Sogn-Labette association.

The minor soils in this association are the Ivan and Osage soils. The calcareous Ivan soils are similar to the Verdigris soils. The poorly drained Osage soils are in slightly concave areas on flood plains.

This association is used almost entirely for cultivated crops, cool-season pasture, and hay. A few small areas are used as woodland or range. The main crops are corn, soybeans, sorghum, wheat, and alfalfa. The main concerns of management are controlling flooding and maintaining good tilth and fertility. A surface drainage system is needed in some areas of the Lanton soils.

5. Clime-Sogn-Labette Association

Moderately deep and shallow, nearly level to moderately steep, well drained and somewhat excessively drained soils that have a clayey or silty subsoil; on uplands

This association is on ridgetops and side slopes that are dissected by many drainageways and creeks. Slopes range from 0 to 30 percent.

This association makes up about 30 percent of the county. It is about 35 percent Clime soils, 22 percent Sogn soils, 11 percent Labette soils, and 32 percent minor soils (fig. 7).

The moderately deep, well drained Clime soils formed in material weathered from calcareous, clayey shale. These moderately sloping to moderately steep soils are on side slopes. Typically, the surface layer is black, calcareous silty clay about 10 inches thick. The subsoil is calcareous, very firm silty clay about 14 inches thick. The upper part is very dark grayish brown, and the lower part is dark grayish brown. The substratum is olive, calcareous silty clay. Calcareous, clayey shale bedrock is at a depth of about 31 inches.

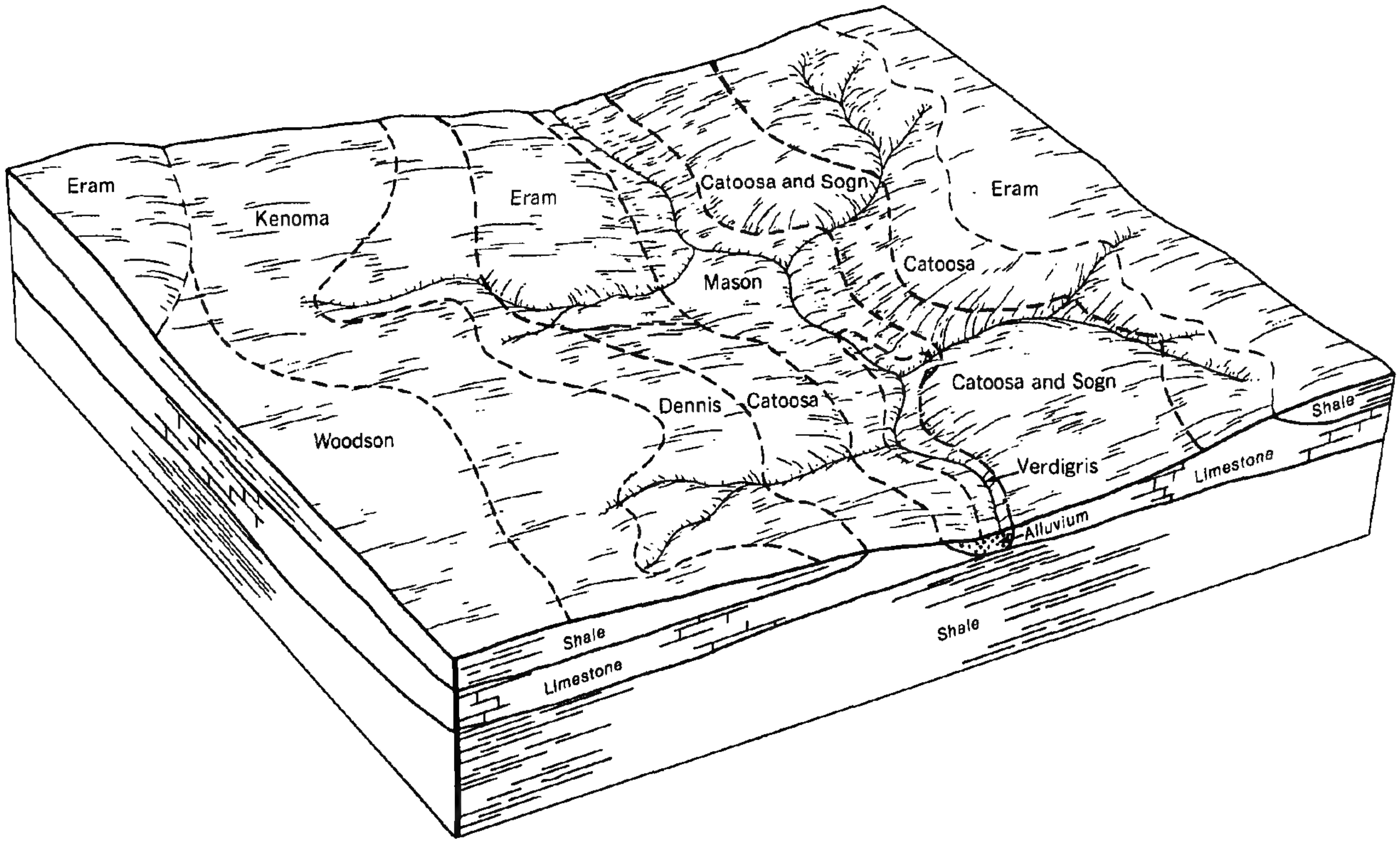


Figure 8.—Typical pattern of soils and underlying material in the Eram-Kenoma-Catoosa association.

The shallow, somewhat excessively drained Sogn soils formed in limestone residuum. These nearly level to strongly sloping soils are on ridgetops and the upper side slopes. Typically, the surface layer is very dark gray silty clay loam about 8 inches thick. Hard limestone bedrock is at a depth of about 8 inches.

The moderately deep, well drained Labette soils formed in material weathered from interbedded limestone and clayey shale. These nearly level to moderately sloping soils are on ridgetops. Typically, the surface layer is very dark brown silty clay loam about 9 inches thick. The subsoil is about 21 inches thick. The upper part is dark brown, firm silty clay loam, and the lower part is dark reddish brown, very firm silty clay. Hard limestone bedrock is at a depth of about 30 inches.

Minor in this association are Eram, Ivan, and Martin soils and rock outcrops. The moderately well drained Eram soils are on side slopes. The deep Ivan soils are on flood plains. The deep Martin soils are on the lower side slopes and foot slopes. The rock outcrops are intermingled with the Sogn soil on the ridgetops.

This association is used primarily as range. Some small areas on foot slopes are used for hay or cultivated crops. Maintaining the growth and vigor of desirable grasses is the main concern of management.

6. Eram-Kenoma-Catoosa Association

Moderately deep and deep, nearly level to moderately sloping, moderately well drained and well drained soils that have a clayey or silty subsoil; on uplands and high terraces

This association is on broad ridgetops and side slopes. Intermittent drainageways are common. Slopes range from 0 to 8 percent.

This association makes up about 29 percent of the county. It is about 27 percent Eram soils, 13 percent Kenoma soils, 12 percent Catoosa soils, and 48 percent minor soils (fig. 8).

The moderately deep, moderately well drained Eram soils formed in shale residuum. These gently sloping and moderately sloping soils are on ridgetops and side slopes. Typically, the surface layer is very dark grayish

brown silt loam about 10 inches thick. The subsoil is about 23 inches thick. The upper part is dark brown, firm silty clay loam, and the lower part is grayish brown, mottled, firm and very firm silty clay. Shale bedrock is at a depth of about 33 inches.

The deep, moderately well drained Kenoma soils formed in old alluvial sediments or in shale residuum. These gently sloping soils are on ridgetops and high terraces. Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is mottled, very firm and extremely firm silty clay about 42 inches thick. The upper part is dark brown, and the lower part is dark yellowish brown. The substratum to a depth of about 60 inches is yellowish brown, mottled silty clay.

The moderately deep, well drained Catoosa soils formed in limestone residuum. These nearly level to moderately sloping soils are on ridgetops and the upper side slopes. Typically, the surface layer is dark brown silt loam about 10 inches thick. The subsoil is dark reddish brown silty clay loam about 24 inches thick. The upper part is friable, and the lower part is firm. Hard limestone bedrock is at a depth of about 34 inches.

The minor soils in this association are the Dennis, Martin, Mason, Sogn, Verdigris, and Woodson soils. Dennis and Martin soils are similar to one or more of the major soils and are in similar landscape positions. The deep Mason soils are on stream terraces that are subject to rare flooding. The shallow Sogn soils are on the upper side slopes. The deep, silty Verdigris soils are on flood plains. The somewhat poorly drained Woodson soils are on upland flats.

This association generally is used for range or for cultivated crops. Some areas are used for hay. Controlling erosion and conserving moisture are concerns in managing cropland. Maintaining and improving the production of desirable grasses are concerns in managing range.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Dennis silt loam, 1 to 4 percent slopes, is one of several phases in the Dennis series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Clime-Sogn complex, 5 to 20 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, quarries, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

The descriptions and names of the soils identified on the detailed soil maps of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications of series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Ba—Bates fine sandy loam, 1 to 4 percent slopes. This moderately deep, gently sloping, well drained soil is on ridgetops and the upper side slopes. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 10 inches thick. The subsoil is about 22 inches thick. The upper part is dark brown, friable loam, and the lower part is dark yellowish brown, mottled, friable clay loam. Soft sandstone bedrock is at a depth of about 32 inches.

Included with this soil in mapping are small areas of the moderately well drained Eram soils, which make up 5 to 10 percent of the map unit. These soils are 20 to 40 inches deep over clayey shale. They are in positions on the landscape similar to those of the Bates soil.

Permeability is moderate in the Bates soil, and available water capacity is low. Surface runoff is medium. Tilth is good. Root development is restricted below a depth of about 32 inches.

About half of the acreage is used for cultivated crops. The rest is used as hayland or range. This soil is moderately well suited to wheat, soybeans, and grain sorghum. Erosion is a hazard if the soil is cultivated. A system of conservation tillage that leaves all or part of the crop residue on the surface, terraces, grassed waterways, and contour farming help to prevent excessive soil loss. Returning crop residue to the soil improves fertility and helps to maintain good tilth.

The native vegetation is dominantly big bluestem, little bluestem, switchgrass, and indiangrass. Overgrazing reduces the extent of the vegetative cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and weeds, such as broom sedge, Baldwin ironweed, and lanceleaf ragweed. Proper stocking rates and a scheduled deferment of grazing during the growing season help to keep the range productive. Invasion of brushy plants, such as sumac, blackberry, and eastern redcedar, is a problem in some areas. Timely burning helps to control most of these plants. Range seeding is needed to restore the productivity of abandoned cropland.

This soil is well suited to dwellings without basements and moderately well suited to dwellings with basements. The depth to bedrock is a limitation on sites for dwellings with basements, but the rock is rippable and can be excavated.

This soil is generally unsuited to septic tank absorption fields and is poorly suited to sewage lagoons because of the depth to bedrock. During the construction of sewage lagoons, fill material should be borrowed or the bedrock ripped. Sealing the bottom of the lagoon helps to prevent excessive seepage into fractures in the bedrock.

The land capability classification is IIe, and the range site is Loamy Upland.

Bb—Bates loam, 4 to 7 percent slopes. This moderately deep, moderately sloping, well drained soil is on side slopes. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is very dark grayish brown loam about 10 inches thick. The subsoil is clay loam about 16 inches thick. The upper part is dark brown and friable, and the lower part is brown, mottled, and firm. Sandy shale and soft sandstone bedrock is at a depth of about 26 inches.

Included with this soil in mapping are small areas of the moderately well drained Eram soils, which make up 5 to 10 percent of the map unit. These soils are 20 to 40 inches deep over clayey shale. They are in landscape positions similar to those of the Bates soil.

Permeability is moderate in the Bates soil, and available water capacity is low. Surface runoff is medium. Tilth is good. Root development is restricted below a depth of about 26 inches.

Most areas are used as range. Some areas have been reseeded to pasture, and a few areas are used as cropland. This soil is moderately well suited to wheat, soybeans, and grain sorghum. Erosion is a hazard if the soil is cultivated. A system of conservation tillage that leaves all or part of the crop residue on the surface, terraces, grassed waterways, and contour farming help to prevent excessive soil loss. Returning crop residue to the soil improves fertility and helps to maintain good tilth.

The native vegetation is dominantly big bluestem, little bluestem, switchgrass, and indiangrass. Overgrazing reduces the extent of the vegetative cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and weeds, such as broom sedge, Baldwin ironweed, and lanceleaf ragweed. Proper stocking rates and a scheduled deferment of grazing during the growing season help to keep the range productive. Invasion of brushy plants, such as sumac, blackberry, and eastern redcedar, is a problem in some areas. Timely burning helps to control most of these plants. Range seeding is needed to restore the productivity of abandoned cropland.

This soil is well suited to dwellings without basements and moderately well suited to dwellings with basements. The depth to bedrock is a limitation on sites for dwellings with basements, but the rock is rippable and can be excavated.

This soil is generally unsuited to septic tank absorption fields and is poorly suited to sewage lagoons because of the depth to bedrock. During the construction of sewage lagoons, fill material should be borrowed or the bedrock ripped. Sealing the bottom of the lagoon helps to prevent excessive seepage into fractures in the bedrock.

The land capability classification is IIIe, and the range site is Loamy Upland.

Bf—Benfield cherty silt loam, 4 to 10 percent slopes. This moderately deep, moderately sloping, well drained soil is on side slopes. Individual areas are irregular in shape and range from 20 to 300 acres in size.

Typically, the surface layer is very dark brown cherty silt loam about 10 inches thick. The subsoil is about 26 inches thick. The upper part is very dark grayish brown, firm cherty silty clay loam. The next part is brown, mottled, firm silty clay loam and brown and yellowish brown, very firm silty clay. The lower part is grayish brown, mottled, calcareous cherty silty clay loam. Calcareous, clayey shale bedrock is at a depth of about 36 inches. In places the subsoil is extremely cherty silty clay.

Included with this soil in mapping are some small areas of Clime and Labette soils. The calcareous Clime soils are on the upper side slopes. Labette soils contain less chert than the Benfield soil. They are on ridgetops. Included soils make up about 15 percent of the map unit.

Permeability is slow in the Benfield soil, and available water capacity is low. Surface runoff is rapid. The shrink-swell potential is high in the subsoil. Root development is restricted below a depth of about 36 inches.

Nearly all areas are used as range. Because of the chert fragments in the surface layer and a severe erosion hazard, this soil is generally unsuited to cultivated crops. It is better suited to range. The native vegetation is dominantly big bluestem, little bluestem, and indiangrass. In overused areas these grasses are replaced by less productive grasses and weeds. Management that maintains an adequate vegetative cover and ground mulch improves the moisture supply by reducing the runoff rate. Proper stocking rates, a uniform distribution of grazing, timely burning, and a scheduled deferment of grazing during the growing season help to keep the range productive.

This soil is poorly suited to dwellings because the shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the structural damage caused by shrinking and swelling.

Because of the depth to bedrock and the slow permeability, this soil is generally unsuited to septic tank absorption fields. It is poorly suited to sewage lagoons because of the depth to bedrock and the slope. Some slope modification helps to keep surface water from entering the lagoon. During the construction of the lagoon, fill material should be borrowed or the bedrock ripped. Sealing the bottom of the lagoon helps to prevent excessive seepage into fractures in the bedrock.

The land capability classification is VIe, and the range site is Loamy Upland.

Cd—Catoosa silt loam, 0 to 2 percent slopes. This moderately deep, nearly level, well drained soil is on ridgetops and the upper side slopes. Individual areas are irregular in shape and range from 10 to 500 acres in size.

Typically, the surface layer is dark brown silt loam about 10 inches thick. The subsoil is dark reddish brown silty clay loam about 24 inches thick. The upper part is friable, and the lower part is firm. Hard limestone bedrock is at a depth of about 34 inches. In some areas the depth to bedrock is more than 40 inches, and in other areas the subsoil is silty clay.

Included with this soil in mapping are small areas of the shallow Sogn soils, which make up 5 to 10 percent of the map unit. These soils are generally lower on the landscape than the Catoosa soil.

Permeability and available water capacity are moderate in the Catoosa soil. Surface runoff is slow. Tilth is good. The shrink-swell potential is moderate in the subsoil. Root development is restricted below a depth of about 34 inches.

About two-thirds of the acreage is used for cultivated crops. The rest is used as hay meadows or range. This soil is well suited to wheat, soybeans, and grain sorghum. Erosion is a hazard if the more sloping areas are cultivated. Also, soil blowing is a hazard if the surface has an inadequate plant cover in the spring. A system of conservation tillage that leaves all or part of the crop residue on the surface, terraces, grassed waterways, and contour farming help to prevent excessive soil loss. Returning crop residue to the soil improves fertility and helps to maintain good tilth.

The native vegetation is dominantly big bluestem, little bluestem, switchgrass, and indiangrass. Overgrazing reduces the extent of the vegetative cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and weeds, such as silver bluestem, Baldwin ironweed, and western ragweed. Proper stocking rates and a scheduled deferment of grazing during the growing season help to keep the range productive. Invasion of brushy plants, such as buckbrush, osageorange, and eastern redcedar, is a problem in some areas. Timely burning helps to control these plants. Range seeding is needed to restore the productivity of abandoned cropland.

This soil is only moderately well suited to dwellings without basements because the shrink-swell potential and the depth to bedrock are limitations. Because of the depth to bedrock, the soil is poorly suited to dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the damage to buildings caused by shrinking and swelling. The areas where the depth to bedrock is more than 40 inches generally can be used as sites for dwellings with basements.

This soil is generally unsuited to septic tank absorption fields and is poorly suited to sewage lagoons because of the depth to bedrock. The areas where the depth to bedrock is more than 40 inches generally can be used as sites for lagoons.

The land capability classification is IIe, and the range site is Loamy Upland.

Cf—Catoosa-Sogn complex, 0 to 8 percent slopes. These nearly level to moderately sloping soils are on ridgetops and side slopes. The moderately deep, well drained Catoosa soil is on slopes above the Sogn soil. The shallow, somewhat excessively drained Sogn soil is near rock outcrops. Individual areas are irregular in shape and range from 20 to several hundred acres in size. They are about 55 percent Catoosa soil and about 35 percent Sogn soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Catoosa soil has a surface layer of dark brown silt loam about 9 inches thick. The subsoil is silty clay loam about 17 inches thick. The upper part is dark brown and friable, and the lower part is reddish brown and firm. Hard limestone bedrock is at a depth of about 26 inches. In places the subsoil is silty clay.

Typically, the Sogn soil has a surface layer of dark brown silty clay loam about 8 inches thick. Hard limestone bedrock is at a depth of about 8 inches.

Included with these soils in mapping are small areas of Clime and Eram soils and limestone outcrops. The calcareous Clime soils and the moderately well drained Eram soils are underlain by clayey shale. They are in areas below the limestone outcrops. Included areas make up about 10 percent of the map unit.

Permeability is moderate in the Catoosa and Sogn soils. Available water capacity is low in the Catoosa soil and very low in the Sogn soil. Surface runoff is medium on the Catoosa soil and rapid on the Sogn soil. The shrink-swell potential is moderate in both soils. Root development is restricted below a depth of about 26 inches in the Catoosa soil and about 8 inches in the Sogn soil.

Nearly all areas are used as range. Some of the less rocky areas are used as hay meadows. Because of a severe hazard of erosion, these soils are generally unsuited to cultivated crops. The soils are better suited to range. The dominant native grasses on the Catoosa soil are big bluestem, little bluestem, switchgrass, and indiangrass. Little bluestem and sideoats grama are more common on the Sogn soil. Overgrazing reduces the extent of the vegetative cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and weeds, such as annual broomweed, prairie threeawn, and ragweed. Proper stocking rates, a uniform distribution of grazing, brush management, and a scheduled deferment of grazing during the growing season help to keep the range productive. Some areas may have a dense growth of brushy plants, such as eastern redcedar, osageorange, and sumac. Brush management may be needed in these areas. Burning in the spring helps to control the woody plants. Pond sites are limited because of the shallowness to bedrock.

The Catoosa soil is generally unsuited to dwellings with basements because of the depth to bedrock. It is only moderately well suited to dwellings without basements because the shrink-swell potential and the depth to bedrock are limitations. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling.

The Catoosa soil is generally unsuited to septic tank absorption fields and sewage lagoons because of the depth to bedrock. Deeper soils on the adjacent foot slopes are better sites for lagoons.

The Sogn soil is generally unsuited to building site development because of the shallow depth to bedrock.

The land capability classification is VIe. The Catoosa soil is in Loamy Upland range site, and the Sogn soil is in Shallow Limy range site.

Ck—Clime stony silty clay loam, 20 to 30 percent slopes. This moderately deep, moderately steep, well drained soil is on the sides of bluffs along the larger creeks. Numerous scattered limestone rocks are on the surface. They are 1 to 2 feet in diameter and 10 to 30 feet apart. Individual areas are long and narrow and range from 20 to 300 acres in size.

Typically, the surface layer is very dark gray, calcareous stony silty clay loam about 10 inches thick. The subsoil is about 17 inches thick. The upper part is dark grayish brown, very firm, calcareous silty clay, and the lower part is gray, mottled, firm, calcareous silty clay loam. The substratum is grayish brown, calcareous shaly silty clay loam. Calcareous, shaly bedrock is at a depth of about 33 inches. In some areas the depth to bedrock is less than 20 inches. In a few areas the soil contains chert. In places the subsoil is reddish brown.

Permeability is slow, and available water capacity is low. Surface runoff is rapid. The shrink-swell potential is moderate in the subsoil. Root development is restricted below a depth of about 33 inches.

Nearly all areas are used as range (fig. 9). Because of a severe hazard of erosion, the slope, and the many stones on the surface, this soil is unsuited to cultivated crops. It is better suited to range or wildlife habitat. It generally supports highly diverse plant species that provide shelter for wildlife. The native vegetation dominantly is little bluestem, big bluestem, indiangrass, and sideoats grama. Prescribed burning can help to maintain a desirable balance of woody plants and grasses. Because of the slope and the many stones on the surface, many areas are infrequently used by livestock. As a result, measures that improve the distribution of grazing are needed. Examples are well distributed watering and salting facilities, prescribed burning, and properly located fences.

Figure 9.—Range in excellent condition in an area of Clime stony silty clay loam, 20 to 30 percent slopes. The grasses conceal the numerous stones on the surface.

This soil is generally unsuited to building site development because of the moderately steep slopes.

The land capability classification is VIIe, and the range site is Limy Upland.

Cm—Clime silty clay, 3 to 7 percent slopes. This moderately deep, moderately sloping, well drained soil is on ridgetops and side slopes. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is black, calcareous silty clay about 10 inches thick. The subsoil is very firm, calcareous silty clay about 14 inches thick. It is dark grayish brown in the upper part and light olive brown in the lower part. The substratum is grayish brown and olive, calcareous silty clay. Clayey shale bedrock is at a depth of about 31 inches. In some areas the soil is noncalcareous throughout. In other areas the subsoil is reddish brown.

Included with this soil in mapping are small areas of the deep, noncalcareous Martin soils, which make up about 10 percent of the map unit. These soils are on the lower side slopes.

Permeability is slow in the Clime soil, and available water capacity is low. Surface runoff is rapid. The shrink-

swell potential is moderate in the subsoil. The surface layer is firm and difficult to till. Root development is restricted below a depth of about 31 inches.

Most areas are used as range. A few areas are used for cultivated crops, and some are abandoned cropland or have been reseeded to grasses. This soil is poorly suited to cultivated crops. The main crops are wheat and grain sorghum. Erosion is a hazard in cultivated areas. A system of conservation tillage that leaves all or part of the crop residue on the surface, terraces, grassed waterways, and contour farming help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material help to maintain fertility and improve tilth. The crop residue also improves the infiltration rate and reduces the runoff rate, thereby conserving moisture.

This soil is suited to grasses for hay or grazing. The native vegetation is dominantly little bluestem, big bluestem, indiangrass, and sideoats grama. In overused areas these grasses are replaced by less productive grasses and by weeds. Management that maintains an adequate vegetative cover and ground mulch improves the moisture supply by reducing the runoff rate. Range seeding is needed to restore the productivity of abandoned cropland. Proper stocking rates, a uniform distribution of grazing, prescribed burning, a scheduled deferment of grazing during the growing season, and restricted use during prolonged wet periods help to keep the range productive. Applications of fertilizer increase the production of pasture grasses.

This soil is only moderately well suited to dwellings because the shrink-swell potential is a limitation. The depth to bedrock also is a limitation on sites for dwellings with basements, but the rock is generally soft and can easily be excavated. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the structural damage caused by shrinking and swelling.

Because of the depth to bedrock, this soil is generally unsuited to septic tank absorption fields and is poorly suited to sewage lagoons. The deep included soils on the lower side slopes are better suited to lagoons.

The land capability classification is IVe, and the range site is Limy Upland.

Cs—Clime-Sogn complex, 5 to 20 percent slopes. These moderately sloping and strongly sloping soils are on side slopes and ridgetops that are dissected by many drainageways. Very narrow bands of exposed limestone bedrock are common. The moderately deep, well drained Clime soil is generally in the more sloping areas, and the shallow, somewhat excessively drained Sogn soil is in the less sloping areas. Individual areas are irregular in shape and range from 20 to a few thousand acres in size. They are about 65 percent Clime soil and 20 percent Sogn soil. The two soils occur as alternating bands so closely intermingled or so narrow that mapping them separately is not practical.

Typically, the Clime soil has a surface layer of black, calcareous silty clay about 10 inches thick. The subsoil is very firm, calcareous silty clay about 14 inches thick. The upper part is very dark grayish brown, and the lower part is dark grayish brown. The substratum is olive, mottled, calcareous silty clay. Calcareous, clayey shale bedrock is at a depth of about 31 inches. In places the subsoil is reddish brown.

Typically, the Sogn soil has a surface layer of very dark gray silty clay loam about 8 inches thick. Hard limestone bedrock is at a depth of about 8 inches.

Included with these soils in mapping are small areas of Dwight, Eram, Labette, and Martin soils and rock outcrops. All of the included soils are noncalcareous throughout. Dwight soils are affected by sodium salts. They are nearly level and are on ridgetops. The moderately well drained Eram soils are in landscape positions similar to those of the Clime soil. Labette soils are 20 to 40 inches deep over limestone. They are generally higher on the landscape than the Sogn soil. The deep Martin soils are on the lower side slopes. The rock outcrops are along the breaks, in the steeper areas, and on side slopes, generally below the Sogn soil. Included areas make up about 15 percent of the map unit.

Permeability is slow in the Clime soil and moderate in the Sogn soil. Available water capacity is low in the Clime soil and very low in the Sogn soil. Surface runoff is rapid on both soils. Root development is restricted below a depth of about 31 inches in the Clime soil and about 8 inches in the Sogn soil. The shrink-swell potential is moderate in both soils.

Nearly all areas are used as range. Some of the less rocky areas are used as hayland. Because of a severe hazard of erosion and the shallowness to limestone, these soils are generally unsuited to cultivated crops. They are better suited to range or wildlife habitat. The plants on these soils can provide protective cover for wildlife if the amounts of grasses and woody plants are properly balanced. The native vegetation on the Clime soil is dominantly little bluestem, big bluestem, and sideoats grama. Sideoats grama is more common on the shallow Sogn soil. In severely overgrazed areas, the range is invaded by annual bromegrass, annual broomweed, and other less desirable vegetation. Management that maintains an adequate vegetative cover conserves moisture by reducing the runoff rate. Proper stocking rates, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. Prescribed burning helps to control brush.

The Clime soil is poorly suited to dwellings because the depth to bedrock and the slope are limitations. The deeper, less sloping soils on foot slopes are better sites.

Because of the slow permeability and the depth to bedrock, the Clime soil is generally unsuited to septic tank absorption fields. It is poorly suited to sewage lagoons because of the depth to bedrock and the slope. The deeper, less sloping soils on the lower side slopes are better sites. If the less sloping areas are selected as sites for the lagoons, less leveling and banking will be needed during construction.

The Sogn soil is generally unsuited to building site development because of the shallow depth to bedrock.

The land capability classification is VIe. The Clime soil is in Limy Upland range site, and the Sogn soil is in Shallow Limy range site.

Cv—Collinsville-Bates fine sandy loams, 2 to 8 percent slopes. These moderately sloping, well drained soils are on ridgetops and the upper side slopes. The Collinsville soil is shallow, and the Bates soil is moderately deep. Individual areas are irregular in shape and range from 20 to 100 acres in size. They are about 55 percent Collinsville soil and 35 percent Bates soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Collinsville soil has a surface layer of very dark brown fine sandy loam about 8 inches thick. The substratum is dark brown fine sandy loam. Sandstone bedrock is at a depth of about 14 inches.

Typically, the Bates soil has a surface layer of very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 20 inches thick. The upper part is dark brown, friable loam, and the lower part is dark yellowish brown, mottled, friable clay loam. Sandstone bedrock is at a depth of about 28 inches.

Included with these soils in mapping are small areas of Steedman soils and small areas where sandstone outcrops are numerous. The moderately well drained Steedman soils generally are in the more sloping areas below the sandstone outcrops. Included areas make up about 10 percent of the map unit.

Permeability is moderately rapid in the Collinsville soil and moderate in the Bates soil. Available water capacity is very low in the Collinsville soil and low in the Bates soil. Surface runoff is medium on both soils. Root development is restricted below a depth of about 14 inches in the Collinsville soil and about 28 inches in the Bates soil.

Nearly all areas are used as range. Because of the erosion hazard on both soils and the shallowness to sandstone bedrock in the Collinsville soil, these soils are generally unsuited to cultivated crops. They are better suited to range. The dominant native grasses on the Collinsville soil are little bluestem, big bluestem, indiangrass, switchgrass, and sideoats grama. Big bluestem is more common on the Bates soil. Overgrazing reduces the extent of the vegetative cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and weeds, such as lanceleaf ragweed, broom sedge, and tall dropseed. Proper stocking rates, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. Overused areas are often invaded by brushy plants, such as sumac, blackberry, and eastern redcedar. Brush management may be needed in these areas. Occasionally burning in the spring helps to control the woody plants.

The Collinsville soil is generally unsuited to building site development because of the shallow depth to bedrock.

The Bates soil is well suited to dwellings without basements. The depth to bedrock is a limitation on sites for dwellings with basements, but the rock is rippable and can be excavated. This soil is generally unsuited to septic tank absorption fields and is poorly suited to sewage lagoons because of the depth to bedrock. During the construction of lagoons, fill material should be borrowed or the bedrock ripped. Sealing the bottom of the lagoon helps to prevent excessive seepage into fractures in the bedrock.

The land capability classification is VIe. The Collinsville soil is in Shallow Sandstone range site, and the Bates soil is in Loamy Upland range site.

De—Dennis silt loam, 1 to 4 percent slopes. This deep, gently sloping, moderately well drained soil is on convex ridgetops, side slopes, and low knolls in the uplands. Individual areas are irregular in shape and range from 10 to more than 300 acres in size.

Typically, the surface layer is very dark brown silt loam about 12 inches thick (fig. 10). The subsoil extends to a depth of more than 60 inches. The upper part is dark brown, mottled, friable silty clay loam; the next part is dark yellowish brown and yellowish brown, mottled, very firm silty clay; and the lower part is yellowish brown, mottled, extremely firm silty clay. In some areas the depth to shale is less than 40 inches. In other areas the subsoil is silty clay in the upper part or is less clayey and redder throughout.

Permeability and surface runoff are slow. Available water capacity is high. Tilth is good. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of about 2 to 3 feet in winter and early in spring.

About half of the acreage is cultivated. The rest is used mainly as range. This soil is well suited to wheat, grain sorghum, soybeans, and alfalfa. Erosion is a hazard if the soil is cultivated. Contour farming, terraces, grassed waterways, and a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil helps to maintain good tilth and fertility.

Figure 10.—Profile of Dennis silt loam, 1 to 4 percent slopes. The arrow indicates the depth to the clayey subsoil. Depth is marked in feet.

The native vegetation is dominantly big bluestem, little bluestem, switchgrass, and indiangrass. Overgrazing reduces the extent of the vegetative cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive plants, such as tall dropseed, western ragweed, and Baldwin ironweed. Proper stocking rates, a uniform distribution of grazing, a scheduled deferment of grazing during the growing season, and timely burning help to keep the range productive. Applications of fertilizer increase the production of pasture grasses.

This soil is poorly suited to dwellings because the shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling and by wetness.

Because of the slow permeability and the wetness, this soil is generally unsuited to septic tank absorption fields. It is well suited to sewage lagoons; however, some land shaping generally is needed to overcome the slope.

The land capability classification is IIe, and the range site is Loamy Upland.

Df—Dennis silt loam, 4 to 7 percent slopes. This deep, moderately sloping, moderately well drained soil is on side slopes and foot slopes. Individual areas are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer is very dark brown silt loam about 13 inches thick. The subsoil extends to a depth of more than 60 inches. The upper part is dark brown, mottled, friable silty clay loam; the next part is brown, dark yellowish brown, and yellowish brown, mottled, very firm silty clay; and the lower part is strong brown, mottled, extremely firm silty clay. In a few small eroded areas, the surface layer is silty clay loam. In some places the depth to shale is less than 40 inches. In other places the subsoil is less clayey and redder.

Permeability is slow, and surface runoff is medium. Available water capacity is high. Tilth is good. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of about 2 to 3 feet in winter and early in spring.

Most areas are used as range or pasture. The rest are used for cultivated crops. This soil is moderately well suited to wheat, grain sorghum, alfalfa, and soybeans. If cultivated crops are grown, erosion is a hazard. Contour farming, terraces, grassed waterways, and a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil helps to maintain good tilth and fertility.

The native vegetation dominantly is big bluestem, little bluestem, switchgrass, and indiangrass. In overused areas the range is invaded by less desirable plants, such as tall dropseed, Baldwin ironweed, and western ragweed. Proper stocking rates, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive.

Range seeding is needed to restore the productivity of abandoned cropland. If the soil is used for hay, early mowing allows the native grasses to recover before the first frost. Timely grazing and mowing and applications of fertilizer generally are needed in pastured areas.

This soil is poorly suited to dwellings because the shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling and by wetness.

Because of the slow permeability and the wetness, this soil is generally unsuited to septic tank absorption fields. It is well suited to sewage lagoons; however, some land shaping is generally needed to overcome the slope.

The land capability classification is IIIe, and the range site is Loamy Upland.

Dg—Dennis silty clay loam, 3 to 7 percent slopes, eroded. This deep, moderately sloping, moderately well drained soil is on side slopes, foot slopes, and old terrace breaks that are dissected by numerous small gullies in some areas. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is dark brown silty clay loam about 7 inches thick. The subsoil extends to a depth of more than 60 inches. The upper part is yellowish brown, firm silty clay loam; the next part is brown and dark yellowish brown, mottled, very firm silty clay; and the lower part is dark yellowish brown and brown, mottled, extremely firm silty clay. In some areas the surface layer is thicker and less clayey. In other areas shale bedrock is at a depth of 20 to 40 inches.

Permeability is slow, and surface runoff is medium. Available water capacity is high. Tilth is fair. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of about 2 to 3 feet in winter and early in spring.

Most areas are used for cultivated crops. Some areas are used as pasture or have been reseeded to grasses. This soil is poorly suited to cultivated crops. Grain sorghum, wheat, alfalfa, and soybeans are the principal crops. If cultivated crops are grown, further erosion is a hazard. Grassed waterways, terraces, and contour farming help to prevent excessive soil loss. Applying a system of conservation tillage that leaves all or part of the crop residue on the surface and returning crop residue to the soil improve tilth and increase the infiltration rate.

This soil is suited to range or pasture plants for hay or grazing. The major concerns in managing range or pasture are erosion and low forage production on abandoned cropland. An adequate plant cover reduces the runoff rate, helps to prevent excessive soil loss, and increases the moisture supply. Seeding grasses helps to restore the productivity of abandoned cropland. Proper stocking rates, a scheduled deferment of grazing during the growing season, and brush control help to keep the range productive. Applications of fertilizer generally are needed in pastured areas. Land shaping is needed in areas where the soil is too gullied for seeding or haying.

This soil is poorly suited to dwellings because the shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling and by wetness.

Because of the slow permeability and the wetness, this soil is generally unsuited to septic tank absorption fields. It is well suited to sewage lagoons; however, some land shaping is generally needed to overcome the slope.

The land capability classification is IVe, and the range site is Loamy Upland.

Dw—Dwight silt loam, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is on ridgetops and some foot slopes. Depressions less than 1 foot deep and less than 20 feet in diameter are common. Individual areas are irregular in shape and range from 10 to 500 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 4 inches thick. The subsoil is extremely firm silty clay about 38 inches thick. The upper part is very dark brown and dark brown, and the lower part is brown and dark yellowish brown. Hard limestone bedrock is at a depth of about 42 inches. In some areas the surface layer is more than 4 inches thick. In other areas the bedrock is shale.

Included with this soil in mapping are small areas of the well drained Labette soils. These soils are 20 to 40 inches deep over limestone. Also included are somewhat poorly drained soils that are more clayey in the surface layer than the Dwight soil. Included soils make up 5 to 10 percent of the map unit.

Permeability is very slow in the Dwight soil, and available water capacity is low. The shrink-swell potential is high in the subsoil. Surface runoff is medium. The surface layer is thin and commonly is mixed with the clayey subsoil during cultivation. The subsoil contains enough sodium to adversely affect the growth of most plants. This soil does not absorb moisture easily or release it readily to plants. Water ponds briefly in the small depressions.

Most areas are used as range. Some areas are abandoned cropland or have been reseeded to pasture or range. Because of the low available water capacity and the excess sodium in the subsoil, this soil is poorly suited to cultivated crops and pasture. It is better suited

to native range. Range in good condition supports a mixture of tall, mid, and short grasses. Overused areas are dominated by short grasses, such as buffalograss and blue grama. Also, they are invaded by weeds, such as prairie threeawn, annual broomweed, and Japanese brome. Proper stocking rates, a uniform distribution of grazing, a scheduled deferment of grazing during the growing season, timely burning, and restricted use during wet periods help to keep the range productive. Range seeding is needed to restore the productivity of abandoned cropland.

The areas of shorter vegetation common on this soil are preferred booming grounds for prairie chickens. Establishing nearby areas of tall grasses for nesting increases or maintains the population of prairie chickens.

This soil is poorly suited to dwellings because the shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling.

Because of the very slow permeability, this soil is generally unsuited to septic tank absorption fields. It is only moderately well suited to sewage lagoons because the depth to bedrock is a limitation. The areas where the soil is deepest over bedrock are the best sites for lagoons.

The land capability classification is IVs, and the range site is Claypan.

Em—Eram silt loam, 1 to 4 percent slopes. This moderately deep, gently sloping, moderately well drained soil is on ridgetops and side slopes. Individual areas are irregular in shape and range from 10 to more than 300 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 10 inches thick. The subsoil is about 23 inches thick. The upper part is dark brown, firm silty clay loam, and the lower part is grayish brown, mottled, firm and very firm silty clay. Clayey and sandy shale bedrock is at a depth of about 33 inches. In places the depth to bedrock is more than 40 inches.

Included with this soil in mapping are small areas of the loamy Bates soils. These soils are in landscape positions similar to those of the Eram soil. Also included are some small areas of the sodium affected Dwight soils on the lower side slopes. Included soils make up 5 to 15 percent of the map unit.

Permeability is slow in the Eram soil, and surface runoff is medium. Available water capacity is low. Tilth is good. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of about 2 to 3 feet in winter and early in spring. Root development is restricted below a depth of about 33 inches.

About two-thirds of the acreage is used as range. The rest is used for cultivated crops, hay, or pasture. This soil is moderately well suited to wheat, soybeans, and grain sorghum. Erosion is the principal hazard if cultivated crops are grown. Contour farming, terraces, grassed waterways, and a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive runoff and soil loss. In a few areas most of the soil overlying the bedrock is removed when terraces are constructed. As a result, the root zone is severely restricted. Constructing the terraces on the contour and in areas where the soil is deepest helps to maintain an adequate root zone. Returning crop residue to the soil improves tilth and fertility and increases the infiltration rate.

The native vegetation is dominantly big bluestem, little bluestem, switchgrass, and indiangrass. In overused areas the extent of less desirable plants, such as Baldwin ironweed and western ragweed, increases. Also, weeds, such as annual broomweed and lanceleaf ragweed, invade the site. Proper stocking rates and a scheduled deferment of grazing during the growing season help to keep the range productive. Invasion of brushy plants, such as sumac, blackberry, osageorange, and eastern redcedar, can become a problem (fig. 11). Timely burning helps to control the unwanted brush and trees. Either chemical or mechanical brush management may be needed in areas where fire-resistant species persist. Range seeding is needed to restore the productivity of abandoned cropland. If the soil is used for hay, early mowing allows the native grasses to recover before the first frost. Timely grazing and haying and applications of fertilizer generally are needed in pastured areas.

This soil is poorly suited to dwellings because the shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling and by wetness.

Because of the depth to bedrock, the wetness, and the slow permeability, this soil generally is unsuited to septic tank absorption fields. It is poorly suited to sewage lagoons because of the depth to bedrock and the wetness. Suitable sites for lagoons generally are available in areas where the depth to bedrock is more than 40 inches.

The land capability classification is IIIe, and the range site is Loamy Upland.

En—Eram silty clay loam, 4 to 7 percent slopes. This moderately deep, moderately sloping, moderately well drained soil is on side slopes. Individual areas are irregular in shape and range from 10 to more than 500 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 9 inches thick. The subsoil is about 21

Figure 11.—Invasion of osageorange in an area of Eram silt loam, 1 to 4 percent slopes.

inches thick. The upper part is very dark gray, firm silty clay loam; the next part is very dark grayish brown, mottled, very firm silty clay; and the lower part is dark gray, mottled silty clay loam. Clayey shale bedrock is at a depth of about 30 inches. In some areas the depth to bedrock is more than 40 inches. In other areas the subsoil is calcareous.

Included with this soil in mapping are small areas of the loamy Bates soils, which make up 5 to 10 percent of the map unit. These soils are in landscape positions similar to those of the Eram soil.

Permeability is slow in the Eram soil, and surface runoff is rapid. Available water capacity is low. The shrink-swell potential is high in the subsoil. The surface layer is firm and somewhat difficult to till. A perched seasonal high water table is at a depth of about 2 to 3 feet in winter and early in spring. Root development is restricted below a depth of about 30 inches.

Most areas are used as range. A few areas are cultivated or have been reseeded to pasture. Some areas are abandoned cropland. This soil is moderately well suited to wheat and grain sorghum. Erosion is a hazard if cultivated crops are grown (fig. 12). Contour farming, terraces, grassed waterways, and a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive runoff and soil loss. In a few areas most of the soil overlying the bedrock is removed when terraces are constructed. As a result, the root zone is severely restricted. Constructing the terraces on the contour and in areas where the soil is deepest helps to maintain an adequate root zone. Returning crop residue to the soil improves tilth and fertility and increases the infiltration rate.

This soil is better suited to range, native hayland, or pasture than to cultivated crops. The native vegetation is dominantly big bluestem, little bluestem, switchgrass,

and indiangrass. Overgrazing reduces the extent of the vegetative cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and weeds, such as tall dropseed, western ragweed, annual broomweed, and Baldwin ironweed. Proper stocking rates, a uniform distribution of grazing, restricted use during prolonged wet periods, and a scheduled deferment of grazing during the growing season help to keep the range productive. Invasion of brushy species, such as sumac, blackberry, osageorange, and eastern redcedar, can become a problem. Timely burning helps to control many of the trees and shrubs. Chemical or mechanical brush management may be needed in areas where fire-resistant species persist. Range seeding is needed to restore the productivity of abandoned cropland. Timely grazing and haying and applications of fertilizer generally are needed in pastured areas. If the soil is used for hay, early mowing allows the native grasses to recover before the first frost.

This soil is poorly suited to dwellings because the shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the damage caused by shrinking and swelling and by wetness.

Because of the moderate depth to bedrock, the wetness, and the slow permeability, this soil generally is unsuited to septic tank absorption fields. It is poorly suited to sewage lagoons because of the depth to bedrock and the wetness. Suitable sites for lagoons generally are available in areas where the depth to bedrock is more than 40 inches. Some land shaping may be needed to keep surface water away from the lagoon.

Figure 12.—Erosion in an area of Eram silty clay loam, 4 to 7 percent slopes.

The land capability classification is IVe, and the range site is Clay Upland.

Eo—Eram silty clay loam, 3 to 7 percent slopes, eroded. This moderately deep, moderately sloping, moderately well drained soil is on side slopes and knolls that are dissected by numerous gullies in some areas. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 6 inches thick. The subsoil is mottled, very firm silty clay about 18 inches thick. The upper part is dark brown, and the lower part is dark grayish brown. The substratum is yellowish brown, mottled clay loam. Clayey shale bedrock is at a depth of about 31 inches. In some areas the surface layer is thicker. In other areas the depth to shale is more than 40 inches.

Included with this soil in mapping are small areas of the loamy Bates soils, which make up 5 to 10 percent of the map unit. These soils are in landscape positions similar to those of the Eram soil.

Permeability is slow in the Eram soil, and surface runoff is rapid. Available water capacity is low. The shrink-swell potential is high in the subsoil. The surface layer is firm, and tilth is poor. A perched seasonal high water table is at a depth of about 2 to 3 feet in winter and early in spring. Root development is restricted below a depth of about 31 inches.

Many areas have been revegetated to grasses and are used mainly for grazing. A few areas are used for cultivated crops. This soil is better suited to pasture and range than to cultivated crops. A cover of pasture or range plants helps to control erosion. Establishing grasses is difficult because of occasional deep gullies and because of the poor tilth in the surface layer. Land shaping commonly is needed to smooth the gullies. Proper stocking rates and a scheduled deferment of grazing during the growing season help to maintain the stand of grasses and help to control further erosion. Applications of fertilizer increase forage production in pastured areas and help to control erosion.

This soil is poorly suited to cultivated crops. If the soil is cultivated, close-growing crops, such as wheat, are best suited. Drought significantly reduces yields because of the low available water capacity. Grassed waterways, terraces, contour farming, and a system of conservation tillage that leaves all or part of the crop residue on the surface help to control erosion and help to maintain the physical condition of the soil. Returning crop residue to the soil and adding other organic material improve tilth. Fertility has been depleted through erosion. It can be improved by incorporating barnyard manure, green manure crops, or commercial fertilizer into the soil.

This soil is poorly suited to dwellings because the shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling and by wetness.

Because of the depth to bedrock, the wetness, and the slow permeability, this soil generally is unsuited to septic tank absorption fields. It is poorly suited to sewage lagoons because of the depth to bedrock and the wetness. Suitable sites for lagoons generally are available in areas where the depth to bedrock is more than 40 inches. Some land shaping may be needed to keep surface water away from the lagoon.

The land capability classification is IVe, and the range site is Clay Upland.

Es—Eram-Dwight silt loams, 1 to 4 percent slopes. These moderately well drained, gently sloping soils are generally on ridgetops but in some areas are on foot slopes. The Eram soil is moderately deep. The Dwight soil is deep and is in the less sloping areas. Individual areas are irregular in shape and range from 10 to 150 acres in size. They are about 70 percent Eram soil and 30 percent Dwight soil. These two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Eram soil has a surface layer of very dark grayish brown silt loam about 10 inches thick. The subsoil is about 20 inches thick. The upper part is very dark brown, firm silty clay loam. The lower part is grayish brown, firm silty clay. It is mottled below a depth of about 15 inches. Olive brown shaly bedrock is at a depth of about 30 inches. In places the depth to bedrock is more than 40 inches.

Typically, the Dwight soil has a surface layer of very dark grayish brown silt loam about 4 inches thick. The subsoil is about 37 inches thick. The upper part is very dark brown and dark brown, very firm silty clay. The lower part is brown, extremely firm silty clay. Clayey shale bedrock is at a depth of about 41 inches. In places the surface layer is thicker.

Permeability is slow in the Eram soil and very slow in the Dwight soil. Available water capacity is low in both soils. The shrink-swell potential is high in the subsoil. The subsoil of the Dwight soil contains enough sodium to adversely affect the growth of most plants. Surface runoff is medium on both soils. Root development is restricted below a depth of about 30 inches in the Eram soil. The Dwight soil does not absorb moisture easily or release it readily to plants. The Eram soil has a perched seasonal high water table at a depth of 2 to 3 feet.

Nearly all areas are used as range or native hayland. Because of the low available water capacity in both soils and the sodium content of the Dwight soil, these soils are poorly suited to cultivated crops. They are better suited to range or hay. The dominant native grasses on the Eram soil are big bluestem, little bluestem,

switchgrass, and indiangrass. The Dwight soil supports a mixture of tall, mid, and short grasses, which do not grow so well as the grasses on the Eram soil. In overgrazed areas less desirable grasses and forbs, such as tall dropseed, Baldwin ironweed, western ragweed, and gayfeather, increase in extent and may dominate. Proper stocking rates and a scheduled deferment of grazing during the growing season help to keep the range productive. Dense stands of brushy plants, such as sumac, blackberry, and eastern redcedar, can become a management problem. Timely burning helps to manage this problem. If the soils are used for hay, early mowing allows the native grasses to recover before the first frost.

These soils are poorly suited to dwellings because the shrink-swell potential is a limitation. Also, the depth to bedrock and the wetness are limitations on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling and by wetness. The bedrock is generally soft enough to be excavated.

Because of the very slow or slow permeability, the wetness, and the depth to bedrock, these soils are generally unsuited to septic tank absorption fields. They are poorly suited to sewage lagoons because of the depth to bedrock. During the construction of the lagoon, fill material should be borrowed or the bedrock ripped. Sealing the bottom of the lagoon helps to prevent excessive seepage into fractures in the bedrock.

The land capability classification is IVe. The Eram soil is in Loamy Upland range site, and the Dwight soil is in Claypan range site.

Fe—Fiat silty clay loam, 1 to 3 percent slopes. This moderately deep, gently sloping, somewhat poorly drained soil is on ridgetops and the upper side slopes. Individual areas are irregular in shape and range from 20 to 200 acres in size.

Typically, the surface layer is black silty clay loam about 11 inches thick. The subsoil is mottled, very firm silty clay about 19 inches thick. The upper part is very dark gray, and the lower part is dark grayish brown. Limestone bedrock is at a depth of about 30 inches. In places the depth to bedrock is more than 40 inches.

Included with this soil in mapping are small areas of the shallow Sogn soils, which make up about 10 percent of the map unit. These soils are in the slightly lower landscape positions.

Permeability is slow in the Fiat soil, and available water capacity is low. Surface runoff is medium. The shrink-swell potential is high in the subsoil. The firm surface layer is somewhat difficult to till and tends to remain very sticky following wet periods. A perched seasonal high water table is at a depth of about 1.5 to 2.0 feet in winter and early in spring. Root development is restricted below a depth of about 30 inches.

About one-third of the acreage is used for cultivated crops. The remainder is used as range or as hay meadows or has been reseeded to pasture. This soil is moderately well suited to wheat, grain sorghum, and soybeans. Erosion is a hazard if cultivated crops are grown. Contour farming, terraces, grassed waterways, and a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the infiltration rate.

This soil is best suited to grasses for hay or pasture. The native vegetation dominantly is big bluestem, little bluestem, switchgrass, and indiangrass. Overgrazing reduces the extent of the vegetative cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and weeds, such as tall dropseed, western ragweed, and Baldwin ironweed. Proper stocking rates, a uniform distribution of grazing, restricted use during prolonged wet periods, and a scheduled deferment of grazing during the growing season help to keep the range productive. If the soil is used for hay, early mowing allows regrowth of the native grasses before the first frost. Timely grazing and haying and applications of fertilizer generally are needed in pastured areas.

This soil is poorly suited to dwellings because the shrink-swell potential and the wetness are limitations. Also, the depth to bedrock is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the damage to buildings caused by shrinking and swelling and by wetness. The areas where the depth to bedrock is more than 40 inches generally can be used as sites for dwellings with basements.

Because of the wetness, the depth to bedrock, and the slow permeability, this soil is generally unsuited to septic tank absorption fields. It is poorly suited to sewage lagoons because of the depth to rock and the wetness. The areas where depth to bedrock is more than 40 inches generally can be used as sites for lagoons.

The land capability classification is IIIe, and the range site is Clay Upland.

Fm—Florence-Martin complex, 2 to 12 percent slopes. These deep, gently sloping to strongly sloping soils are on ridgetops and side slopes. The well drained Florence soil is on rounded ridgetops and side slopes, and the moderately well drained Martin soil is on the lower side slopes. Scattered coarse cherty fragments are on the surface in most areas. Some areas are dissected

by many deeply entrenched drainageways. Individual areas are irregular in shape and range from 20 to several hundred acres in size. They are about 60 percent Florence soil and 30 percent Martin soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Florence soil has a surface layer of very dark brown cherty silt loam about 6 inches thick. The subsurface layer is very dark brown very cherty silt loam about 6 inches thick. The subsoil is about 37 inches thick. The upper part is very dark grayish brown, firm extremely cherty silty clay loam. The next part is dark red and dark brown, very firm extremely cherty silty clay. The lower part is dark red, mottled, extremely firm extremely cherty clay (fig. 13). Cherty limestone bedrock is at a depth of about 49 inches. In places the silty surface layer is much thicker.

Typically, the Martin soil has a surface layer of black silty clay loam about 9 inches thick. The subsoil is silty clay about 46 inches thick. The upper part is very dark gray and firm. The lower part is very dark grayish brown and grayish brown, mottled, and very firm. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay. In places the soil has a reddish brown subsoil and is less than 40 inches deep to bedrock.

Included with these soils in mapping are small areas of Clime and Dwight soils. The calcareous, moderately well drained Clime soils are 20 to 40 inches deep over shale. They are on side slopes. Dwight soils are affected by sodium. They are on ridgetops. Included soils make up 10 to 15 percent of the map unit.

Permeability is moderately slow in the Florence soil and slow in the Martin soil. The shrink-swell potential is moderate in the subsoil of the Florence soil and high in the subsoil of the Martin soil. Available water capacity is low in the Florence soil and moderate in the Martin soil. Surface runoff is rapid on the Florence soil and medium on the Martin soil. The Martin soil has a perched seasonal high water table at a depth of about 2 to 3 feet in winter and early in spring.

Most areas are used as range. A few of the less cherty areas on foot slopes formerly were cultivated but are now abandoned cropland. Because the chert fragments interfere with tillage and erosion is a severe hazard, these soils are generally unsuited to cultivated crops. They are better suited to range. The native vegetation is dominantly big bluestem, little bluestem, and indiangrass. Overgrazing reduces the extent of the vegetative cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and weeds, such as tall dropseed, annual broomweed, Baldwin ironweed, and western ragweed. Proper stocking rates, a uniform distribution of grazing, timely burning, and a scheduled deferment of grazing during the growing season help to keep the range productive. Range

Figure 13.—There are chert fragments throughout the Florence soil in the Florence-Martin complex, 2 to 12 percent slopes. Depth is marked in feet.

seeding is needed to restore the productivity of abandoned cropland.

The Florence soil is only moderately well suited to dwellings because the shrink-swell potential is a limitation. Also, chert fragments are a limitation on sites for dwellings without basements, and the depth to bedrock is a limitation on sites for dwellings with basements. The Martin soil is poorly suited to dwellings because the shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations and basement walls, installing foundation drains, and backfilling with suitable coarse material around the foundations and basements help to prevent the structural damage caused by shrinking and swelling and by wetness.

Because of the slow permeability, these soils are generally unsuited to septic tank absorption fields. They are only moderately well suited to sewage lagoons because of the slope. Some slope modification may be needed.

The land capability classification is VIe, and the range site is Loamy Upland.

Iv—Ivan silt loam, channeled. This deep, nearly level, well drained soil is on narrow flood plains that are dissected by meandering stream channels. It is frequently flooded. Individual areas are long and are 250 to 800 feet wide.

Typically, the surface layer is very dark grayish brown, calcareous silt loam about 19 inches thick. The next layer is very dark grayish brown, calcareous, friable silt loam about 14 inches thick. The substratum to a depth of about 60 inches is dark brown, calcareous silt loam. In some areas the surface layer has thin, grayish brown strata, and in other areas the soil is noncalcareous.

Included with this soil in mapping are small areas of Osage, Martin, and Dennis soils. All of these soils are noncalcareous and have a subsoil that is more clayey than that of the Ivan soil. Martin and Dennis soils are on foot slopes. The poorly drained Osage soils are in swales. Also included are small areas of the somewhat poorly drained Lanton soils on low stream terraces. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the Ivan soil, and available water capacity is very high. Surface runoff is slow. The shrink-swell potential is moderate.

Most areas are used as range. A few areas are used as pasture or woodland. This soil is generally unsuited to cultivated crops because of the flooding. Many areas of range are overgrazed and in poor condition because they are near watering facilities and shade trees where cattle congregate. In these areas the desirable grasses have been replaced by less productive grasses, forbs, and weeds. Range productivity can be increased by deferring grazing during the growing season and grazing during the winter months.

This soil is well suited to trees. A few areas remain in native hardwoods. Flooding and plant competition are management concerns. Seeds, cuttings, and seedlings can be successfully established if competing vegetation is controlled by site preparation, including controlled burning or spraying, and by selective cutting. Important species include black walnut, pecan, bur oak, hackberry, eastern cottonwood, and green ash.

The vegetation commonly on this soil provides habitat for many kinds of wildlife, including quail, deer, wild turkey, rabbits, and numerous songbirds. The wildlife population can be increased by increasing the number of fringe areas where woodland joins cropland and grassland. These areas provide food and shelter for wildlife.

This soil is generally unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is Vw, and the range site is Loamy Lowland.

Iw—Ivan silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains. Individual areas are irregular in shape and range from 10 to more than 200 acres in size.

Typically, the surface layer is very dark grayish brown, calcareous silt loam about 8 inches thick. The subsurface layer is very dark grayish brown, friable, calcareous silt loam about 25 inches thick. The next layer to a depth of about 60 inches is dark brown, friable, calcareous silt loam. In places the soil is noncalcareous throughout.

Included with this soil in mapping are small areas of the somewhat poorly drained Lanton soils, which make up 5 to 10 percent of the map unit. These soils are on low stream terraces.

Permeability is moderate in the Ivan soil, and available water capacity is very high. Surface runoff is slow. Tilth is good. The shrink-swell potential is moderate.

Most areas are used for cultivated crops. The rest are used as pasture or woodland. This soil is well suited to corn, sorghum, soybeans, wheat, and alfalfa. Flooding can damage crops and may delay spring planting in some years. Terraces and conservation tillage on the adjacent uplands help to control flooding on this soil. Crop rotation helps to control weeds, plant diseases, and insect carry-over.

This soil is well suited to pasture and hay. Grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, restricted use during wet periods, and deferred grazing help to keep the grass and soil in good condition. Applications of fertilizer and timely mowing generally are needed in pastured areas. Timely mowing of grass for hay allows the plants to recover.

This soil is well suited to trees. Flooding and plant competition are concerns of management. Tree cuttings

and seedlings can be successfully established if competing vegetation is controlled by site preparation, including controlled burning or spraying, and by selective cutting. Important species include black walnut, pecan, bur oak, hackberry, eastern cottonwood, and green ash.

Fringe areas where cropland, grassland, and woodland are adjacent to each other provide habitat for many wildlife species, including deer, quail, wild turkey, and numerous songbirds. Good woodland and grassland management increases the wildlife population.

This soil is generally unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIw, and the range site is Loamy Lowland.

Kd—Kenoma silt loam, 1 to 3 percent slopes. This deep, gently sloping, moderately well drained soil is on broad upland ridgetops and high terraces. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is silty clay about 42 inches thick. The upper part is dark brown, mottled, and very firm. The lower part is dark yellowish brown, mottled, and extremely firm. The substratum to a depth of about 60 inches is yellowish brown, mottled silty clay. The surface layer is silty clay loam or silty clay in areas where it has been mixed with the upper part of the subsoil by plowing. In some areas the upper part of the subsoil is friable silty clay loam, and in other areas the subsoil is gray.

Included with this soil in mapping are small areas of the moderately deep Catoosa and Eram soils. Catoosa soils are slightly lower on the ridgetops than the Kenoma soil. Eram soils are on the more sloping areas. Included soils make up 5 to 10 percent of the map unit.

Permeability is very slow in the Kenoma soil, and surface runoff is slow. Available water capacity is moderate. Tilth is good. The shrink-swell potential is high in the subsoil.

About two-thirds of the acreage is used as range, hayland, or pasture. The remainder is used for cultivated crops. This soil is moderately well suited to wheat, grain sorghum, alfalfa, and soybeans. Because of the dense, clayey subsoil, seasonal wetness or droughtiness is a limitation. Erosion is a hazard if cultivated crops are grown. Contour farming, terraces, grassed waterways, and a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil helps to maintain good tilth, conserves moisture, and increases the infiltration rate.

The native vegetation is dominantly big bluestem, little bluestem, indiangrass, and switchgrass. In areas that are continually overgrazed, these grasses are replaced by less desirable plants, such as tall dropseed, buffalograss, annual broomweed, and western ragweed. Proper stocking rates and a scheduled deferment of grazing during the growing season help to keep the range productive. Early mowing of the native grasses used for hay allows the plants to recover before the first frost.

The pastured areas of this soil support mainly cool-season grasses. They are used for grazing and for hay. Controlled grazing and timely mowing help to keep the pasture in good condition. Applications of fertilizer increase plant growth and vigor.

This soil is poorly suited to dwellings because the shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling.

Because of the very slow permeability, this soil is generally unsuited to septic tank absorption fields. It is well suited to sewage lagoons; however, some land shaping may be needed to overcome the slope.

The land capability classification is IIIe, and the range site is Clay Upland.

La—Labette silty clay loam, 1 to 4 percent slopes. This moderately deep, gently sloping, well drained soil is on ridgetops and the upper side slopes. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is very dark brown silty clay loam about 9 inches thick. The subsoil is about 21 inches thick. The upper part is dark brown, firm silty clay loam, and the lower part is dark reddish brown, very firm silty clay. Hard limestone bedrock is at a depth of about 30 inches. In places, the depth to bedrock is more than 40 inches and the subsoil is gray.

Included with this soil in mapping are small areas of Sogn soils, which make up 5 to 10 percent of the map unit. These soils are less than 20 inches deep over limestone and are near rock outcrops.

Permeability is slow in the Labette soil, and available water capacity is low. Surface runoff is medium. Tilth is good. The shrink-swell potential is high in the subsoil. Root development is restricted below a depth of about 30 inches.

Most of the acreage is used as range, pasture, or native hayland. A few areas are used for cultivated crops. This soil is moderately well suited to wheat, soybeans, and grain sorghum. Erosion is a hazard if the soil is cultivated. A system of conservation tillage that leaves all or part of the crop residue on the surface, terraces, grassed waterways, and contour farming help to prevent excessive soil loss. Returning crop residue to the soil improves fertility and helps to maintain good tilth.

The native vegetation is dominantly big bluestem, little bluestem, and indiangrass. Overgrazing reduces the extent of the vegetative cover and causes deterioration of the plant community. Under these conditions, the

taller grasses are replaced by less productive grasses, forbs, and weeds, such as tall dropseed, annual broomweed, Baldwin ironweed, and western ragweed. Proper stocking rates and a scheduled deferment of grazing during the growing season help to keep the range productive. Invasion of brushy plants, such as osageorange and sumac, can become a problem. Timely burning helps to manage many of these plants, but chemicals are needed to control sumac. Range seeding is needed to restore the productivity of abandoned cropland. If the soil is used for hay, early mowing allows the grasses to recover before the first frost.

This soil is poorly suited to dwellings because the shrink-swell potential is a limitation. Also, the depth to bedrock is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling. The areas where the depth to bedrock is more than 40 inches generally can be used as sites for dwellings with basements.

Mainly because of the depth to bedrock, this soil generally is unsuited to septic tank absorption fields and is poorly suited to sewage lagoons. Areas where the depth to bedrock is more than 40 inches generally can be used as sites for lagoons.

The land capability classification is IIe, and the range site is Loamy Upland.

Ld—Labette-Dwight complex, 0 to 3 percent slopes. These nearly level and gently sloping soils are on ridgetops. The Labette soil is moderately deep and well drained, and the Dwight soil is deep and moderately well drained. Individual areas are irregular in shape and range from 10 to 500 acres in size. They are about 65 percent Labette soil and 35 percent Dwight soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Labette soil has a surface layer of very dark brown silty clay loam about 9 inches thick. The subsoil is about 21 inches thick. The upper part is dark brown, firm silty clay loam, and the lower part is dark reddish brown, very firm silty clay. Hard limestone bedrock is at a depth of about 30 inches. In a few places the subsoil is gray.

Typically, the Dwight soil has a surface layer of black silt loam about 4 inches thick. The subsoil is extremely firm silty clay about 38 inches thick. The upper part is very dark grayish brown and dark brown, and the lower part is dark yellowish brown and calcareous. Hard limestone bedrock is at a depth of about 42 inches.

Permeability is slow in the Labette soil and very slow in the Dwight soil. Available water capacity is low in both soils. The subsoil in the Dwight soil contains enough sodium to adversely affect the growth of most plants. Surface runoff is medium on both soils. The shrink-swell potential is high in the subsoil. Root development is restricted below a depth of about 30 inches in the Labette soil. The Dwight soil does not absorb moisture easily or release it readily to plants.

Most areas are used as native hayland or range. A few areas are used for cultivated crops. Because of the low available water capacity, these soils are poorly suited to cultivated crops. They are better suited to range or pasture. The dominant native grasses on the Labette soil are big bluestem, little bluestem, and indiangrass. The Dwight soil supports tall, mid, and short grasses, which do not grow so well as the grasses on the Labette soil. In overgrazed areas the taller grasses are replaced by short grasses, forbs, and weeds. Proper stocking rates, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. Range seeding is needed to restore the productivity of abandoned cropland. Timely grazing and mowing and applications of fertilizer generally are needed in pastured areas. If the soils are used as hayland, early mowing allows the grasses to recover before the first frost.

The diverse vegetation common on these soils provides good habitat for prairie chickens. The areas of the Dwight soil that support short grasses are favored sites for booming grounds. The tall grasses provide nesting areas for the prairie chickens.

These soils are poorly suited to dwellings because the shrink-swell potential is a limitation. Also, the depth to bedrock in the Labette soil is a limitation on sites for dwellings with basements. As a result, the deep Dwight soil is a better site. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling.

These soils are generally unsuited to septic tank absorption fields because of the very slow or slow permeability and the depth to bedrock. The deep Dwight soil is a better site for sewage lagoons than the moderately deep Labette soil.

The land capability classification is IIIe. The Labette soil is in Loamy Upland range site, and the Dwight soil is in Claypan range site.

Lg—Labette-Sogn silty clay loams, 0 to 8 percent slopes. These nearly level to moderately sloping soils are on ridgetops and side slopes. The Labette soil is moderately deep and well drained. The Sogn soil is shallow and somewhat excessively drained. It is generally near rock outcrops. Individual areas are irregular in shape and range from 20 to several hundred acres in size. They are about 55 percent Labette soil and 35 percent Sogn soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Labette soil has a surface layer of very dark brown silty clay loam about 9 inches thick. The subsoil is about 17 inches thick. The upper part is dark brown, firm silty clay loam, and the lower part is dark reddish brown, very firm silty clay. Hard limestone bedrock is at a depth of about 26 inches.

Typically, the Sogn soil has a surface layer of very dark gray silty clay loam about 8 inches thick. Hard limestone bedrock is at a depth of about 8 inches. In places the surface layer is stony silty clay loam.

Included with these soils in mapping are small areas of Clime soils and limestone outcrops. The calcareous Clime soils are underlain by clayey shale and are in areas below the limestone outcrops. Included areas make up about 10 percent of the map unit.

Permeability is slow in the Labette soil and moderate in the Sogn soil. Available water capacity is low in the Labette soil and very low in the Sogn soil. Surface runoff is rapid on both soils. The shrink-swell potential is high in the subsoil of the Labette soil and is moderate in the Sogn soil. Root development is restricted below a depth of about 26 inches in the Labette soil and about 8 inches in the Sogn soil.

Nearly all of the acreage is used as range. Because erosion is a severe hazard and rockiness interferes with tillage, these soils are generally unsuited to cultivated crops. They are better suited to range. The dominant native vegetation is big bluestem, little bluestem, indiangrass, and, on the Sogn soil, sideoats grama. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses, forbs, and weeds. Proper stocking rates, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. Brushy plants, such as osageorange and sumac, invade in some areas. Brush management is needed in these areas. Burning in the spring helps to control most of the woody plants. The number of suitable pond sites is limited because of the shallowness to bedrock.

The Labette soil is poorly suited to dwellings because the shrink-swell potential is a limitation. Also, the depth to bedrock is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling.

Because of the depth to bedrock, the Labette soil is generally unsuited to septic tank absorption fields and is poorly suited to sewage lagoons. Deeper soils on the adjacent foot slopes are suitable sites for lagoons.

The Sogn soil is generally unsuited to building site development because it is shallow over bedrock.

The land capability classification is VIe. The Labette soil is in Loamy Upland range site, and the Sogn soil is in Shallow Limy range site.

Ln—Lanton silty clay loam, occasionally flooded. This deep, nearly level, somewhat poorly drained soil is on flood plains. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 7 inches thick. The subsurface layer is very dark gray and black silty clay loam about 29 inches thick. It is generally mottled below a depth of about 14 inches. The substratum to a depth of about 60 inches is dark grayish brown, mottled silty clay. In some areas the depth to silty clay is less than 20 inches. In other areas the soil does not have mottles.

Permeability is moderately slow, and available water capacity is high. Surface runoff is slow. Tilth is good. The shrink-swell potential is moderate in the subsoil. A seasonal high water table is at a depth of about 1 to 2 feet in winter and spring.

Most areas are used for cultivated crops. A few areas are used as pasture. This soil is well suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Tillage is sometimes delayed because of the wetness. Drainage ditches help to remove excess surface water. Keeping tillage at a minimum and leaving crop residue on the surface help to maintain good tilth and fertility. Crop rotation helps to control weeds, plant diseases, and insect carry-over.

This soil is well suited to hay and pasture. Overgrazing and haying or grazing when the soil is too wet cause surface compaction and poor tilth. Overgrazing also reduces the vigor and retards the growth of the grasses. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture in good condition. Applications of fertilizer increase forage production.

This soil is well suited to trees, but only a few areas are native woodland. Plant competition limits the establishment of trees. It can be controlled by careful site preparation, including prescribed burning, spraying, and cutting. Equipment should be operated during periods when the soil is dry. Important species include black walnut, pecan, bur oak, and green ash.

This soil is generally unsuited to building site development because of the flooding.

The land capability classification is IIw, and the range site is Loamy Lowland.

Mb—Martin silty clay loam, 1 to 4 percent slopes. This deep, gently sloping, moderately well drained soil is on side slopes and foot slopes along drainageways. Individual areas are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer is black silty clay loam about 12 inches thick. The subsoil to a depth of about

60 inches is silty clay. The upper part is very dark gray and firm; the next part is very dark gray and dark grayish brown, mottled, and very firm; and the lower part is grayish brown, mottled, and extremely firm. In a few small eroded areas, the surface layer is silty clay. In some areas the depth to shale bedrock is less than 40 inches.

Permeability is slow, and surface runoff is medium. Available water capacity is high. Tilth is good. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of 2 to 3 feet in winter and early in spring.

About half of the acreage is used for cultivated crops. The rest is used as range, hayland, or pasture. This soil is well suited to sorghum, soybeans, wheat, and alfalfa. If the soil is cultivated, erosion is a hazard. A system of conservation tillage that leaves all or part of the crop residue on the surface, contour farming, terraces, and grassed waterways help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material help to maintain fertility and improve tilth.

In the areas used as range, the dominant grasses are big bluestem, little bluestem, and indiangrass. Overgrazing reduces the extent of the vegetative cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses, forbs, and weeds. Proper stocking rates, a uniform distribution of grazing, a scheduled deferment of grazing during the growing season, and restricted use during prolonged wet periods help to keep the range productive. If the soil is used for hay, early mowing allows the grasses to recover before the first frost. Timely grazing and applications of fertilizer generally are needed in pastured areas (fig. 14).

This soil is poorly suited to dwellings because the shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling and by wetness.

Because of the slow permeability, this soil is generally unsuited to septic tank absorption fields. It is only moderately well suited to sewage lagoons because of the slope. Some slope modification may be needed.

The land capability classification is IIe, and the range site is Loamy Upland.

Mc—Martin silty clay loam, 4 to 7 percent slopes. This deep, moderately well drained, moderately sloping soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 10 to 400 acres in size.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsoil is silty clay about 46 inches thick. The upper part is very dark gray and firm; the next part is dark grayish brown, mottled, and very firm; and the lower part is grayish brown, mottled, and very firm. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay. In a few small eroded areas, the surface layer is silty clay. In some areas the depth to shale is less than 40 inches.

Included with this soil in mapping are small areas of the moderately deep, calcareous Clime soils, which make up 5 to 10 percent of the map unit. These soils are generally on the upper side slopes.

Permeability is slow in the Martin soil, and surface runoff is medium. Available water capacity is moderate. Tilth is good. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of 2 to 3 feet in winter and early in spring.

Most areas are used as range, hayland, or pasture. The rest are used for cultivated crops. This soil is moderately well suited to wheat, soybeans, and sorghum. If the soil is cultivated, erosion is a hazard. A system of conservation tillage that leaves all or part of the crop residue on the surface, terraces, grassed waterways, and contour farming help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material help to maintain fertility and improve tilth.

In the areas used as range, the dominant grasses are big bluestem, little bluestem, and indiangrass. In overused areas less productive grasses and weeds, such as tall dropseed, annual broomweed, and buffalograss, make up a larger part of the plant community. Proper stocking rates, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. If the soil is used for hay, the native grasses should be mowed early enough to allow the plants to recover and store food before the first frost. Applications of fertilizer increase forage production.

This soil is poorly suited to dwellings because the shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling and by wetness.

Because of the slow permeability, this soil is generally unsuited to septic tank absorption fields. It is only moderately well suited to sewage lagoons because of the slope. Some slope modification may be needed.

The land capability classification is IIIe, and the range site is Loamy Upland.

Me—Martin silty clay, 3 to 7 percent slopes, eroded. This deep, moderately well drained, moderately sloping soil is on side slopes and foot slopes in the uplands. Some areas are dissected by numerous gullies.

Figure 14.—Tall fescue in an area of Martin silty clay loam, 1 to 4 percent slopes.

Individual areas are irregular in shape and range from 10 to 50 acres in size.

Typically, the surface layer is very dark gray silty clay about 7 inches thick. The subsoil is silty clay about 45 inches thick. The upper part is black and very dark grayish brown and is very firm; the next part is olive brown, mottled, and extremely firm; and the lower part is light olive brown, mottled, and extremely firm. The substratum to a depth of about 60 inches is olive brown and dark grayish brown silty clay. In some areas the surface layer is thicker, is silty clay loam, and is more friable. In other areas the depth to shale is less than 40 inches.

Included with this soil in mapping are small areas of the moderately deep, calcareous Clime soils, which make up 5 to 10 percent of the map unit. These soils are generally on the upper side slopes.

Permeability is slow in the Martin soil, and surface runoff is rapid. Available water capacity is moderate. Tilth is poor. The shrink-swell potential is high in the subsoil. The content of organic matter is moderately low. A perched seasonal high water table is at a depth of about 2 to 3 feet in winter and early in spring.

Nearly all areas formerly were cultivated, but only about half are now used for cultivated crops, mainly wheat, soybeans, and sorghum. Some areas have been reseeded to grasses or remain abandoned cropland. This soil is poorly suited to cultivated crops. Further erosion is the main hazard. Also, the soil is droughty in the summer because it absorbs and releases moisture slowly. Terraces, contour farming, grassed waterways,

and minimum tillage help to control runoff and erosion. Leaving crop residue on the surface and adding barnyard manure increase the infiltration rate and improve tilth.

This soil is better suited to pasture and range than to cultivated crops. A cover of grasses is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, a scheduled deferment of grazing during the growing season, brush management, and restricted use during wet periods help to keep the pasture and range productive. Range seeding is needed to restore the productivity of abandoned cropland. Some areas should be smoothed before they are reseeded. Applications of fertilizer in the pastured areas increase forage production and help to control erosion.

This soil is poorly suited to dwellings because the shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling and by wetness.

Because of the slow permeability, this soil is generally unsuited to septic tank absorption fields. It is only moderately well suited to sewage lagoons because of the slope. Some land shaping may be needed.

The land capability classification is IVe, and the range site is Loamy Upland.

Mn—Mason silt loam. This deep, nearly level, well drained soil is on stream terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to 500 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsoil is firm silty clay loam about 32 inches thick. The upper part is dark brown, and the lower part is brown. The substratum to a depth of about 60 inches is dark yellowish brown silty clay loam. In some areas the subsoil is silt loam. In other areas the soil is calcareous throughout.

Included with this soil in mapping are small areas of the somewhat poorly drained Lanton soils on the slightly lower stream terraces. Also included are some areas of steeper soils along the terrace breaks. Included soils make up 5 to 10 percent of the map unit.

Permeability is moderately slow in the Mason soil, and available water capacity is very high. Surface runoff is slow. Tilth is good. The shrink-swell potential is moderate in the subsoil.

Most areas are used for cultivated crops. A few areas are used as pasture or hayland. This soil is well suited to corn, grain sorghum, soybeans, wheat, and alfalfa (fig. 15). A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth and fertility and helps to prevent the excessive soil loss caused by scouring when the soil is flooded. Crop rotation helps to control weeds, plant diseases, and insect carry-over.

This soil is suited to hay and pasture. Proper stocking rates, pasture rotation, timely deferment of haying or grazing, and restricted use during wet periods help to keep the stand of grasses in good condition. Applications of fertilizer increase forage production.

This soil is suited to trees. Plant competition hinders the establishment of seedlings. It can be controlled by careful site preparation and by spraying or cutting. No hazards or limitations affect planting and harvesting. Important species include black walnut, hackberry, bur oak, pecan, and green ash.

This soil is poorly suited to dwellings because of the flooding. The highest areas on the landscape should be selected as sites for buildings. Levees and dikes help to overcome the hazard of flooding.

This soil is poorly suited to septic tank absorption fields because the moderately slow permeability restricts the absorption of effluent. Enlarging the size of the absorption field helps to overcome this limitation. The soil is well suited to sewage lagoons.

The land capability classification is I, and the range site is Loamy Lowland.

Nc—Newtonia silt loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on high terraces. Individual areas are irregular in shape and range from 10 to 75 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark brown silt loam about 4 inches thick. The subsoil extends to a depth of more than 60 inches. The upper part is dark reddish brown, firm silty clay loam; the next part is yellowish red, mottled, firm silty clay loam; and the lower part is yellowish red, mottled, very firm silty clay. In places the upper part of the subsoil is silty clay.

Permeability is moderate, and runoff is slow. Available water capacity is high. Tilth is good. The shrink-swell potential is moderate in the subsoil.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat, corn, grain sorghum, soybeans, and alfalfa. Erosion is a hazard if the soil is cultivated. Contour farming, crop residue management, grassed waterways, and terraces help to control erosion. A system of conservation tillage that leaves all or part of the crop residue on the surface helps to maintain good tilth, the organic matter content, and fertility. Crop rotation helps to control weeds, plant diseases, and insect carry-over.

This soil is only moderately well suited to dwellings because the moderate shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable

Figure 15.—Alfalfa baled for use as winter feed in an area of Mason silt loam.

coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The moderate permeability restricts the absorption of effluent in septic tank systems. Increasing the size of the absorption field helps to overcome this limitation. Seepage and slope are limitations on sites for sewage lagoons. Sealing the floor and walls of the lagoon helps to control seepage. Some land shaping may be needed to overcome the slope.

The land capability classification is IIe, and the range site is Loamy Upland.

Nd—Niotaze-Darnell complex, 6 to 35 percent slopes. These moderately sloping to steep soils are on ridgetops and side slopes. The Niotaze soil is moderately deep and somewhat poorly drained. The Darnell soil is shallow and well drained. Individual areas are irregular in shape and range from 10 to several hundred acres in size. They are about 75 percent Niotaze soil and about 15 percent Darnell soil. These two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Niotaze soil has a surface layer of very dark grayish brown cobbly fine sandy loam about 3 inches thick. The subsurface layer is pale brown fine sandy loam about 4 inches thick. The subsoil is about 23

inches thick. The upper part is strong brown, firm silty clay; the next part is light olive brown, mottled, very firm silty clay; and the lower part is grayish brown, mottled, very firm clay. Clayey shale and sandstone bedrock is at a depth of about 30 inches.

Typically, the Darnell soil has a surface layer of very dark grayish brown fine sandy loam about 4 inches thick. The subsoil is dark yellowish brown, very friable fine sandy loam about 8 inches thick. Sandstone bedrock is at a depth of about 12 inches.

Included with these soils in mapping are small areas of Prue and Stephenville soils. The deep, moderately well drained Prue soils are on foot slopes and along drainageways. The well drained Stephenville soils are on ridgetops and the upper side slopes. Included soils make up about 10 percent of the map unit.

Permeability is slow in the Niotaze soil and moderately rapid in the Darnell soil. Available water capacity is low in the Niotaze soil and very low in the Darnell soil. The shrink-swell potential is high in the subsoil of the Niotaze soil. Surface runoff is rapid on both soils. Root development is restricted below a depth of about 30 inches in the Niotaze soil and 12 inches in the Darnell soil. The Niotaze soil has a perched seasonal high water table at a depth of about 1 to 2 feet in winter and spring.

These soils are used as range. They are best suited to this use. Nearly all areas have an overstory of blackjack oak and post oak. The understory of grasses is mainly little bluestem and big bluestem. The major concerns of management are undesirable plants and erosion. Management that maintains a good vegetative cover and ground mulch helps to prevent excessive soil loss, reduces the runoff rate, and conserves moisture. Overgrazing reduces the extent of the vegetative cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by the less productive grasses, by weeds, and by oak trees. Proper stocking rates, timely burning, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. Trees can be controlled by spraying or selective cutting.

These soils are generally not productive as woodland. Some trees, however, are cut for firewood.

If managed properly, these soils provide habitat for many wildlife species, including deer, wild turkey, quail, and many nongame birds. Proper grazing use, brush management, and establishment of feeding areas increase or maintain the wildlife population.

These soils are poorly suited to dwellings. Limitations include the slope, the wetness, the high shrink-swell potential, and the shallow depth to bedrock. The less sloping parts of the landscape should be selected as sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the structural damage caused by shrinking and swelling and by wetness. The deeper soils should be selected as sites for dwellings with basements.

Mainly because of the slope and the depth to bedrock, these soils are generally unsuited to sewage disposal systems. Some areas on the adjacent foot slopes are suitable sites.

The land capability classification is VIe. The Niotaze soil is in Savannah range site, and the Darnell soil is in Shallow Savannah range site.

Os—Osage silty clay loam, occasionally flooded. This deep, nearly level, poorly drained soil is on flood plains. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is black silty clay loam about 11 inches thick. The subsoil is mottled, very firm silty clay about 35 inches thick. The upper part is very dark gray, and the lower part is dark gray. The substratum to a depth of about 60 inches is grayish brown, mottled silty clay. In places the upper part of the subsoil is silty clay loam.

Permeability is very slow, and available water capacity is moderate. Surface runoff is slow. The shrink-swell potential is very high in the subsoil. The surface layer is firm and somewhat difficult to till. A seasonal high water table is within a depth of 1 foot in winter and spring.

Most of the acreage is used for cultivated crops, but some is used as pasture. This soil is well suited to grain sorghum, soybeans, and wheat. Wetness and flooding can delay farming and reduce yields. Field drainage ditches, a bedding system, or land leveling may be needed to remove excess surface water. Deep chiseling improves internal drainage and aeration. Fall tillage improves the seedbed for the following spring. Winter freezing and thawing result in a loose, granular surface structure to a depth of 3 or 4 inches. Returning crop residue to the soil improves tilth and increases the infiltration rate. Crop rotation helps to control weeds, plant diseases, and insect carry-over.

This soil is well suited to pasture and hay. Overgrazing and haying or grazing during wet periods, however, cause surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the stands of grasses in good condition. Applications of fertilizer improve production.

A few areas support native hardwoods. This soil is moderately well suited to trees. Because of the wetness, the use of equipment is limited to dry periods. Tree cuttings and seedlings grow well if competing vegetation is controlled or removed. Careful site preparation and spraying or cutting reduce the rate of seedling mortality and help to control plant competition.

This soil is generally unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIw, and the range site is Loamy Lowland.

Po—Pits, quarries. This map unit consists of areas from which soil and some of the underlying limestone or shale have been removed. The underlying material has been quarried for use as gravel or for the manufacturing of cement, brick, and agricultural lime. Individual areas are irregular in shape and range from 10 to 500 acres in size.

A typical quarry is a pit surrounded by vertical walls 10 to 40 feet high. Piles of rock, shale, and gravel are around the outer edges of some quarries.

This map unit is unsuitable for cultivation and for most other uses. The surface is generally bare. Scattered trees, shrubs, and clumps of grass border the quarries.

No land capability classification or range site is assigned to this map unit.

Pr—Prue fine sandy loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on foot slopes. Individual areas are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 11 inches thick. The subsoil extends to a depth of more than 60 inches. The upper part is dark brown, mottled, very friable loam; the next part is yellowish brown and pale brown, mottled, friable clay loam; and the lower part is yellowish brown, mottled, firm silty clay loam. In a few small eroded areas, the surface layer is loam. In some areas the depth to shale is less than 40 inches.

Permeability is moderately slow, and surface runoff is medium. Available water capacity is high. Tilth is good.

Most areas are used as pasture. The rest are used for cultivated crops. This soil is well suited to wheat, grain sorghum, alfalfa, and soybeans. If cultivated crops are grown, erosion is a hazard. Contour farming, terraces, grassed waterways, and a system of conservation tillage that leaves all or part of the crop residue on the surface help to prevent excessive soil loss. Returning crop residue to the soil helps to maintain good tilth and fertility.

This soil is suited to hay and pasture. Proper stocking rates, a uniform distribution of grazing, and timely deferment of grazing help to keep the stand of grasses in good condition. Timely grazing and haying and applications of fertilizer generally are needed in pastured areas.

This soil is well suited to dwellings. It is poorly suited to septic tank absorption fields and moderately well suited to sewage lagoons. The moderately slow permeability is a limitation on sites for septic tank absorption fields. Increasing the size of the absorption field or installing two absorption fields that are used alternately helps to overcome this limitation. Seepage and slope are limitations on sites for sewage lagoons. Sealing the floor and walls of the lagoon helps to control seepage. If the less sloping areas are selected as sites for the lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIIe, and the range site is Loamy Upland.

Sh—Sogn silty clay loam, 0 to 3 percent slopes. This shallow, nearly level and gently sloping, somewhat excessively drained soil is on ridgetops. Numerous outcrops and limestone rocks are on the surface. Individual areas are generally long and narrow and range from 20 to 300 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 8 inches thick. Hard limestone bedrock is at a depth of about 8 inches. In places the surface layer is stony silty clay loam.

Included with this soil in mapping are small areas of the moderately deep Catoosa and Clime soils. Catoosa soils are on the higher parts of the ridgetops. The calcareous Clime soils are 20 to 40 inches deep over clayey shale. They are on side slopes below the Sogn soil and the limestone outcrops. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Sogn soil, and available water capacity is very low. Surface runoff is rapid. The shrink-swell potential is moderate. Root development is restricted below a depth of about 8 inches.

Nearly all areas are used as range. Because of the rockiness, this soil is unsuited to cultivated crops. It is better suited to range. The dominant native grasses are little bluestem and sideoats grama. Overgrazing reduces the extent of the vegetative cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and by weeds. Proper stocking rates, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. Because of dense stands of brushy species, such as osageorange and aromatic sumac, brush management may be needed. Burning in the spring helps to control most of the woody plants.

This soil is generally unsuited to building site development because of the shallow depth to bedrock.

The land capability classification is VIIs, and the range site is Shallow Limy.

St—Steedman stony loam, 5 to 20 percent slopes. This moderately deep, moderately well drained, moderately sloping and strongly sloping soil is on uplands. Numerous sandstone rocks are on the surface. They are 1 to 2 feet in diameter and 10 to 30 feet apart. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface layer is very dark grayish brown stony loam about 7 inches thick. The subsoil is mottled,

firm and very firm silty clay about 29 inches thick. The upper part is dark brown, the next part is brown, and the lower part is grayish brown and light olive brown. Clayey shale bedrock is at a depth of about 36 inches. In some areas the surface layer is silty clay loam more than 10 inches thick. In other areas the depth to shale is more than 40 inches.

Included with this soil in mapping are narrow bands of fractured sandstone outcrops. The rocks are as much as 4 feet in diameter and cover about 15 percent of the surface. Also included are small areas of the moderately deep Bates and shallow Collinsville soils. These soils are generally intermingled with the sandstone outcrops along ridgetops. Bates soils have a loamy subsoil and are underlain by sandstone. Included areas make up 5 to 10 percent of the map unit.

Permeability is slow in the Steedman soil, and available water capacity is low. The shrink-swell potential is high in the subsoil. Surface runoff is rapid. Root development is restricted below a depth of about 36 inches. A perched seasonal high water table is at a depth of about 0.5 to 1.0 foot in winter and early in spring.

Nearly all areas are used as range. Because erosion is a severe hazard and surface stones interfere with tillage, this soil is generally unsuited to cultivated crops. It is better suited to range. The native vegetation dominantly is little bluestem, big bluestem, indiangrass, and switchgrass. Overgrazing reduces the extent of the vegetative cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses, weeds, and brushy species, such as lanceleaf ragweed, blackberry vines, and sumac. Proper stocking rates, a uniform distribution of grazing, prescribed burning, and a scheduled deferment of grazing during the growing season help to keep the range productive. Many areas are potential sites for ponds (fig. 16).

Figure 16.—A pond in an area of Steedman stony loam, 5 to 20 percent slopes.

The vegetation on this soil can provide protective cover for wildlife if the amounts of grasses and woody plants are properly balanced.

This soil is poorly suited to dwellings because of the shrink-swell potential and wetness. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material around the foundations help to prevent the structural damage caused by shrinking and swelling and by wetness.

Because of the moderate depth to bedrock and the slow permeability, this soil generally is not suited to septic tank absorption fields. It is poorly suited to sewage lagoons because of the depth to bedrock and the slope. The areas where depth to bedrock is more than 40 inches are the better sites for lagoons. Some land shaping is needed to modify the slope.

The land capability classification is VIe, and the range site is Loamy Upland.

Sv—Stephenville fine sandy loam, 1 to 4 percent slopes. This moderately deep, well drained, gently sloping soil is on ridgetops. Individual areas are irregular in shape and range from 20 to 100 acres in size.

Typically, the surface layer is dark brown fine sandy loam about 6 inches thick. The subsurface layer is dark yellowish brown fine sandy loam about 5 inches thick. The subsoil is yellowish red, firm sandy clay loam about 21 inches thick. It is mottled in the lower part. Sandstone bedrock is at a depth of about 32 inches. In a few places the depth to bedrock is more than 40 inches.

Included with this soil in mapping are small areas of the shallow Darnell soils, which make up about 5 percent of the map unit. These soils are in landscape positions similar to those of the Stephenville soil.

Permeability is moderate in the Stephenville soil, and available water capacity is low. Surface runoff is slow. Root development is restricted below a depth of about 32 inches.

Most areas are used as range. Most have an overstory of trees. A few small areas have been cleared and are used as pasture or cropland. This soil is moderately well suited to wheat, grain sorghum, and soybeans, but it is subject to serious erosion if cultivated. A system of conservation tillage that leaves all or part of the crop residue on the surface, terraces, grassed waterways, and contour farming help to prevent excessive soil loss. Returning crop residue to the soil improves fertility and helps to maintain good tilth.

This soil is suited to range and pasture. The native vegetation is dominantly big bluestem and little bluestem and an overstory of post oak and blackjack oak. If the range or pasture is overgrazed, the more desirable grasses are replaced by less productive grasses, by weeds, and by oak trees. Proper stocking rates, a uniform distribution of grazing, a scheduled deferment of grazing during the growing season, and timely burning help to keep the stand of grasses in good condition. Trees can be controlled by spraying or selective cutting. Applications of fertilizer increase forage production in pastured areas.

This soil generally is unproductive as woodland. Some trees, however, are cut for firewood.

This soil is well suited to dwellings without basements and moderately well suited to dwellings with basements. The depth to bedrock is a limitation on sites for dwellings with basements, but the rock is rippable and can be excavated. Because of the depth to bedrock, the soil is generally unsuited to septic tank absorption fields and is poorly suited to sewage lagoons. During the construction of lagoons, fill material should be borrowed or the bedrock ripped. Sealing the bottom of the lagoon helps to prevent excessive seepage into fractures in the bedrock.

The land capability classification is IIe, and the range site is Savannah.

Sw—Stephenville-Darnell fine sandy loams, 1 to 6 percent slopes. These well drained, gently sloping soils are on ridgetops and the upper side slopes. The Stephenville soil is moderately deep, and the Darnell soil is shallow. Individual areas are irregular in shape and range from 20 to 500 acres in size. They are about 50 percent Stephenville soil and 40 percent Darnell soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Stephenville soil has a surface layer of dark brown fine sandy loam about 6 inches thick. The subsurface layer is dark yellowish brown fine sandy loam about 5 inches thick. The subsoil is yellowish red, firm sandy clay loam about 21 inches thick. It is mottled in the lower part. Sandstone bedrock is at a depth of about 32 inches. In a few places the depth to bedrock is more than 40 inches.

Typically, the Darnell soil has a surface layer of very dark grayish brown fine sandy loam about 4 inches thick. The subsoil is dark yellowish brown, very friable gravelly fine sandy loam about 8 inches thick. Sandstone bedrock is at a depth of about 12 inches.

Included with these soils in mapping are small areas of Niotaze soils and sandstone outcrops. The outcrops are generally below or scattered throughout areas of the Darnell soil. The somewhat poorly drained Niotaze soils are in areas below the outcrops. Included areas make up about 10 percent of the map unit.

Permeability is moderate in the Stephenville soil and moderately rapid in the Darnell soil. Available water capacity is low in the Stephenville soil and very low in the Darnell soil. Surface runoff is medium on both soils. Root development is restricted below a depth of about 32 inches in the Stephenville soil and 12 inches in the Darnell soil.

Most areas are used as woodland that has an understory of shrubs and grasses. A few of the less rocky areas formerly were cultivated but are now

abandoned cropland. Because erosion is a severe hazard and the rockiness interferes with tillage, these soils are generally not suited to cultivated crops. They are generally not productive as woodland; however, some trees are harvested for firewood.

These soils are better suited to native range and pasture than to cultivated crops. The dominant vegetation is post oak and blackjack oak and an understory of grasses, such as big bluestem and little bluestem. If the range or pasture is overgrazed, the more desirable grasses are replaced by less productive mid and short grasses and by weeds and brush. Grass production is severely reduced when the oak canopy becomes too thick. Proper stocking rates, a uniform distribution of grazing, a scheduled deferment of grazing during the growing season, and brush control help to keep the range productive. Tree density can be controlled by selective spraying, cutting, or clearing. Forage production is low on abandoned cropland. It can be increased by seeding mid and tall grasses.

The diverse vegetation of trees, shrubs, and grasses on these soils provides good habitat for wildlife, such as deer, quail, wild turkey, and numerous songbirds. Measures that control brush and help to establish feeding areas increase or maintain the wildlife population.

The Stephenville soil is well suited to dwellings without basements and moderately well suited to dwellings with basements. The depth to bedrock is a limitation on sites for dwellings with basements; however, the rock is rippable and can be excavated.

Because of the depth to bedrock, the Stephenville soil is generally unsuited to septic tank absorption fields. It is poorly suited to sewage lagoons because of the depth to bedrock and seepage. During the construction of lagoons, fill material should be borrowed or the bedrock ripped. Sealing the bottom of the lagoon helps to prevent excessive seepage into fractures in the bedrock. Some slope modification may be needed.

Because of depth to bedrock, the Darnell soil is generally unsuited to septic tank absorption fields and sewage lagoons and is poorly suited to dwellings. The deeper Stephenville soil is better suited to building site development.

The land capability classification is VIe. The Stephenville soil is in Savannah range site, and the Darnell soil is in Shallow Savannah range site.

Vd—Verdigris silt loam, channeled. This deep, nearly level, well drained soil is on narrow flood plains that are dissected by meandering stream channels. It is frequently flooded. Individual areas are long and are 250 to 800 feet wide.

Typically, the surface layer is very dark grayish brown silt loam about 17 inches thick. The next layer is dark brown, friable silt loam about 30 inches thick. The substratum to a depth of about 60 inches is dark brown silt loam. In some areas the soil is calcareous. In other areas the surface layer has thin, grayish brown strata.

Included with this soil in mapping are small areas of the moderately well drained Martin and Dennis soils. These soils are on foot slopes. They make up about 15 percent of the map unit.

Permeability is moderate in the Verdigris soil, and available water capacity is very high. Surface runoff is slow. The shrink-swell potential is moderate.

Most areas are used as range. A few areas are used as pasture or woodland. Because of the flooding, this soil is generally unsuited to cultivated crops. It is better suited to range. Many areas of range are overgrazed and in poor condition because they are near watering facilities and shade trees where cattle congregate. In these areas the more desirable grasses are replaced by less productive grasses, brush, and weeds. Range productivity can be increased by deferring grazing during the growing season and grazing during the winter months.

A few areas support native hardwoods. This soil is well suited to trees. Flooding and plant competition limit the establishment and growth of trees. Tree seeds, cuttings, and seedlings grow well if competing vegetation is controlled or removed by site preparation, including spraying or selective cutting. Important species include black walnut, pecan, bur oak, hackberry, eastern cottonwood, and green ash.

The vegetation commonly on this soil provides habitat for many wildlife species, including quail, deer, wild turkey, rabbits, and numerous songbirds. The wildlife population can be increased or maintained by providing more fringe areas where woodland joins cropland or grassland.

This soil is generally unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is Vw, and the range site is Loamy Lowland.

Vf—Verdigris silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains. Individual areas are irregular in shape and range from 10 to more than 200 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark brown, friable silt loam about 20 inches thick. The next layer is dark brown, friable silt loam about 27 inches thick. The substratum to a depth of about 60 inches is dark grayish brown silt loam. In places the soil is calcareous.

Permeability is moderate, and available water capacity is very high. Surface runoff is slow. Tilth is good. The shrink-swell potential is moderate.

Most areas are used for cultivated crops. The rest are used as pasture or woodland. This soil is well suited to corn, sorghum, soybeans, wheat, and alfalfa. Floodwater

can damage crops and can delay spring planting in some years. Terraces and a system of conservation tillage on the adjacent uplands help to control flooding on this soil. Crop rotation helps to control weeds, plant diseases, and insect carry-over.

This soil is well suited to grasses for grazing or hay. Grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, restricted use during wet periods, and deferred grazing help to keep the stand of grasses in good condition. Applications of fertilizer generally are needed in pastured areas. Timely mowing of grass for hay allows the plants to recover.

This soil is well suited to trees. Flooding and plant competition limit the establishment and growth of trees. Tree cuttings and seedlings grow well if competing vegetation is controlled by site preparation, including spraying or selective cutting. Important species include black walnut, pecan, bur oak, hackberry, eastern cottonwood, and green ash.

Fringe areas where cropland, grassland, and woodland are adjacent to each other provide habitat for many wildlife species, including deer, quail, wild turkey, and numerous songbirds. Forest management practices help to maintain or increase the wildlife population.

This soil is generally unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIw, and the range site is Loamy Lowland.

Wo—Woodson silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on broad upland flats. Individual areas are irregular in shape and range from 20 to more than 500 acres in size.

Typically, the surface layer is very dark gray silt loam about 8 inches thick. The subsoil is silty clay about 38 inches thick. The upper part is black and very firm; the next part is very dark gray, mottled, and extremely firm; and the lower part is light brownish gray, mottled, and firm. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay. In some areas the subsoil is brown. In other areas the surface layer is silty clay.

Permeability is very slow, and surface runoff is slow. Available water capacity is moderate. Tilth is good. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of about 0.5 foot to 2.0 feet in winter and early in spring.

About half of the acreage is used for cultivated crops or pasture, and half is used as range. This soil is well suited to wheat, alfalfa, soybeans, and sorghum. Tillage is often delayed in the spring because of wetness. A surface drainage system is needed in some areas. Because the clayey subsoil does not release moisture readily to plants, crop yields are often reduced during periods of drought. Returning crop residue to the soil improves tilth, conserves moisture, and helps to maintain fertility.

This soil is suited to range and pasture. Maintaining a good vegetative cover is the main concern of grassland management. Overgrazing reduces the extent of the vegetative cover and causes deterioration of the plant community. Under these conditions, the taller grasses are replaced by less productive grasses and weeds, such as annual broomweed, tall dropseed, and buffalograss. Overgrazing or grazing during prolonged wet periods compacts the surface and reduces the rate of water infiltration. Proper stocking rates, a uniform distribution of grazing, timely burning, restricted use during wet periods, and a scheduled deferment of grazing during the growing season help to keep the grass in good condition. Applications of fertilizer increase forage production.

This soil is poorly suited to dwellings. The wetness and the shrink-swell potential are limitations. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the structural damage caused by wetness and by shrinking and swelling.

Because of the very slow permeability and the wetness, this soil is generally unsuited to septic tank absorption fields. It is well suited to sewage lagoons.

The land capability classification is IIs, and the range site is Clay Upland.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil economically to produce a sustained high yield of crops. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has

few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 185,000 acres in the survey area, or nearly 45 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, mainly in the Mason-Verdigris-Lanton and Eram-Kenoma-Catoosa associations, which are described under the heading "General Soil Map Units." About 70,000 acres of this prime farmland is used for crops.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify for prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name on the following list. Onsite evaluation is needed to determine whether or not the limitation has been overcome by corrective measures.

The map units that meet the soil requirements for prime farmland are:

Ba	Bates fine sandy loam, 1 to 4 percent slopes
Bb	Bates loam, 4 to 7 percent slopes
Cd	Catoosa silt loam, 0 to 2 percent slopes
De	Dennis silt loam, 1 to 4 percent slopes
Df	Dennis silt loam, 4 to 7 percent slopes
Em	Eram silt loam, 1 to 4 percent slopes
Fe	Fiat silty clay loam, 1 to 3 percent slopes
Iw	Ivan silt loam, occasionally flooded
Kd	Kenoma silt loam, 1 to 3 percent slopes
La	Labette silty clay loam, 1 to 4 percent slopes
Ln	Lanton silty clay loam, occasionally flooded (where drained)
Mb	Martin silty clay loam, 1 to 4 percent slopes
Mc	Martin silty clay loam, 4 to 7 percent slopes
Mn	Mason silt loam
Nc	Newtonia silt loam, 1 to 3 percent slopes
Os	Osage silty clay loam, occasionally flooded (where drained)
Pr	Prue fine sandy loam, 2 to 6 percent slopes
Sv	Stephenville fine sandy loam, 1 to 4 percent slopes
Vf	Verdigris silt loam, occasionally flooded
Wo	Woodson silt loam, 0 to 2 percent slopes

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. The survey can be used to adjust land uses to the limitations and potentials of the natural resources and the environment in the survey area. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. This soil survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this soil survey to locate sources of sand and gravel, roadfill, and topsoil. They can use the survey to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

The soils in this survey area have been assigned to various interpretive groups. These groups are listed at the end of each map unit description and in some of the tables. The interpretive groups for each map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey.

Crops and Pasture

John C. Dark, conservation agronomist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 80,000 acres in Elk County, or 19 percent of the total acreage, is used for cultivated crops or hay. During the period 1971 to 1981, wheat was grown on about 26 percent of the cropland, soybeans on 9 percent, grain sorghum on 15 percent, alfalfa on 13 percent, and other hay crops on 30 percent. The remaining 7 percent was used for silage, corn, oats, and other crops (*3*). The acreage used for soybeans, grain sorghum, and wheat increased during this period compared to that of the previous 10-year period. The acreage of all other crops remained the same or decreased.

The crops are grown mainly on Mason, Ivan, Verdigris, Catoosa, Dennis, and Kenoma soils. Lesser acreages of Fiat, Eram, Lanton, Martin, Labette, Bates, Newtonia, Osage, Prue, and Woodson soils also are used as cropland.

Crop production can be increased on most farms by applying the latest technology. This soil survey can facilitate the application of such technology. The main concerns in managing the soils in Elk County are controlling erosion, maintaining or improving fertility and tilth, and reducing wetness.

Erosion is a hazard on about 35 percent of the cropland in Elk County. Most of the erosion occurs on soils that have a slope of more than 1 or 2 percent. Examples are Bates, Dennis, Eram, Fiat, Kenoma, Labette, Martin, Newtonia, and Prue soils.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the

surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as Kenoma, Dennis, Martin, and Woodson soils. Secondly, erosion results in sedimentation in streams. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water.

Erosion-control practices provide a protective cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the surface for extended periods helps to control erosion and preserves the productive capacity of the soils. Terraces and diversions shorten the length of slopes, reduce the runoff rate, and help control erosion. They are most practical on deep, well drained soils that have uniform slopes. Contour farming should generally be used in combination with terraces. It is best suited to those soils that have smooth, uniform slopes and are suitable for terracing.

Plants on most of the arable soils in the county respond well to applications of nitrate and phosphate fertilizers. On all soils the amount of fertilizer needed should be based on the results of soil tests, on the needs of the crop, on the expected level of yields, and on the experience of farmers. The Cooperative Extension Service can help to determine the kinds and amounts of fertilizer needed.

Organic matter is a storehouse of available plant nutrients. It increases the water intake rate, helps to prevent surface crusting, helps to control erosion, and promotes good tilth. Most of the soils in the county that are used for crops have a silt loam surface layer. Intensive rainfall causes the surface to crust. When dry, the crusted surface becomes nearly impervious to water. As a result, the runoff rate is increased. A conservation tillage system that leaves all or part of the crop residue on the surface helps to prevent crusting, increases the rate of water infiltration, reduces the runoff rate, and helps to control erosion (fig. 17).

A drainage system is a management need on some soils on flood plains. Unless drained, some areas of the somewhat poorly drained Lanton and poorly drained Osage soils are so wet that crop yields are reduced. Surface drains or a bedding system can reduce the wetness.

Information about the design of erosion-control practices is available in the local office of the Soil Conservation Service. The latest information about growing crops can be obtained from the Cooperative Extension Service or the Soil Conservation Service.

About 4 percent of the acreage in Elk County is pastured (*6*). The pastured areas support mainly cool-season grasses, such as tall fescue and smooth bromegrass. They are throughout the county.

The main concerns in managing pasture are maintaining or improving the quality and quantity of forage, protecting the soil, and conserving water. Leaf development, root growth, forage regrowth, and food storage in roots are processes in the development and growth of grasses. All are essential if optimum yields of forage are to be maintained.

Proper stocking rates help to maintain a good stand of grasses. The numbers of livestock should be adjusted to the expected level of yields. Forage and feed should be provided to livestock for the entire season. As a guide, 40 pounds of forage per mature cow per day is needed if the pasture is grazed continuously throughout the grazing season and 35 pounds per mature cow per day if rotation grazing is used.

Delaying grazing in the spring until the soil is dry and firm helps to prevent the damage caused by trampling and compaction. Tall fescue and bromegrass should not be grazed during their midsummer dormancy. Rotation grazing is a system that provides an adequate number of pastures with sufficient acreage in ratio to the number of livestock. It helps to prevent depletion of a pasture by allowing the grasses to recover after periods of grazing. Maintaining an adequate ground cover during the periods of grazing helps to control erosion.

Providing adequate supplies of water and salt at a variety of locations results in a uniform distribution of grazing. Applying the proper kinds and amounts of fertilizer according to the results of soil tests, field observation, and the experience of farmers increases forage production. Mowing a pasture that has been grazed unevenly or has an excess of forage and spraying with herbicides help to control invading trees, brush, and broad-leaved weeds.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

Figure 17.—Soybeans planted into wheat stubble, an example of no-till planting. The soil is Mason silt loam.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops,

the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units," in the yields table, and in the section "Interpretive Groups."

Rangeland

Steven L. Ekblad, range conservationist, Soil Conservation Service, helped prepare this section.

About 272,000 acres in Elk County, or 66 percent of the total acreage, is range. In many areas an additional acreage of pasture and native hay supplements the forage provided by range. The range is in the Bluestem Hills major land resource area in the western part of the county and in the Cross Timbers major land resource area in the eastern part.

Cow-calf operations are the major type of livestock enterprise. Yearling operations are throughout the county but are concentrated in the Bluestem Hills part. Some stocker-feeder operations are in areas where cropland is adjacent to or intermingled with the range.

If properly managed, nearly all of the soils in the county have excellent potential for producing quality forage plants for livestock and wildlife. Because of the unique combination of soils, climate, and topography, the range responds readily to well planned grazing management.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. An explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre

of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Excellent range condition is highly desirable on practically all of the range in Elk County. At the present time, only 25 percent of the range is producing close to its potential. About 5 percent is abandoned cropland on which revegetation is needed to restore the natural plant community. On about 40 percent of the range, brush management is needed before the natural plant community can meet its potential. The brush has invaded mostly on the Savannah, Shallow Savannah, and Limy Upland range sites. A combination of grazing management, revegetation, and brush management restores these sites to an excellent condition. The rest of the range can be restored to its potential by good grazing management.

Woodland Management and Productivity

Keith A. Ticknor, forester, Soil Conservation Service, helped prepare this section.

About 24,800 acres in Elk County, or nearly 6 percent of the total acreage, is forested. The acreage of forest has decreased steadily in recent years, mainly because of the conversion of woodland to cropland or pasture. The woodland occurs as areas in the upland drainageways, as irregular tracts along streams, and as some areas of upland soils that are underlain by shale or sandstone bedrock. Numerous trees have invaded pasture or have been planted along fence rows and farm boundaries.

The woodland is divided into three main forest cover types—post oak-blackjack oak, bur oak, and hackberry-American elm-green ash. The post oak-blackjack oak forest cover type is in upland areas of the Niotaze-Darnell-Stephenville soil association, which is described under the heading "General Soil Map Units." Some tracts are nearly pure stands of post oak and blackjack oak.

The bur oak forest cover type is in upland areas of the Clime-Sogn-Labette association. On these dry upland sites, bur oak is associated with other species, such as black oak, northern red oak, chinkapin oak, bitternut hickory, honeylocust, and common pricklyash.

The hackberry-American elm-green ash forest cover type is in areas of the Mason-Verdigris-Lanton association on bottom land. A large number of associated species are in these areas, including bitternut hickory, bur oak, boxelder, black willow, American sycamore, eastern cottonwood, black walnut, Kentucky coffeetree, silver maple, and pawpaw.

Many of the trees, especially the bottom land species, have commercial value for wood products. Many of the soils have good potential for Christmas trees and for the trees used in the production of veneer, sawtimber, and other wood products. Only a small part of the woodland, however, is managed for commercial wood production. Most of the wooded areas are privately owned tracts making up only a small acreage of the farms. Most of the acreage is cropland that is unlikely to be converted to land used for commercial wood production. The soils on bottom land produce high-value hardwoods within a short period. In contrast, upland soils produce low-value trees over a long period.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each suitable soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. It is based on the site index of the

species listed first in the *common trees* column. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *r* indicates steep slopes; *x*, stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted rooting depth; *c*, clay in the upper part of the soil; *s*, sandy texture; and *f*, high content of coarse fragments in the soil profile. The letter *a* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: r, x, w, t, d, c, s, and f.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade where there are openings in the tree canopy. The invading plants compete with native plants or planted seedlings. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

Windbreaks and Environmental Plantings

Keith A. Ticknor, forester, Soil Conservation Service, helped prepare this section.

Trees grow on most of the farmsteads in Elk County. They were planted at various times by the landowners. Some of these are windbreaks, but most are environmental or ornamental plantings. Eastern redcedar is the most common species in the windbreaks. Other commonly planted species are Siberian elm, pecan, black walnut, lilac, green ash, and hackberry.

A few windbreaks and many environmental plantings are planted each year. Tree planting is a continual need because old trees pass maturity and deteriorate, because some trees are destroyed by insects, disease, or storms, and because new plantings are needed on expanding farmsteads.

Many field windbreaks are established throughout the county. They generally are hedgerows of osageorange. They were planted as property lines and field boundaries, as living fences, and as a source of wood for posts. Many of these windbreaks are being removed because fields are being enlarged.

In order for windbreaks and environmental plantings to fulfill their intended purpose, the soils on the site should be suited to the trees or shrubs selected for planting. Permeability, available water capacity, fertility, soil depth, and texture greatly affect the growth rate.

Trees and shrubs can be easily established in the county. The survival rate may be restricted, however, mainly by competition from weeds and grasses. The main management needs are proper site preparation before the trees and shrubs are planted and measures that control the competing weeds and grasses after the trees and shrubs are planted.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The

plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

Elk County has several areas of scenic, geologic, and historical interest. Most of the county is in the heart of the Bluestem Hills major land resource area, which is characterized by large ranches. Limestone outcrops line the valley walls. Wooded hillsides and streambanks add to the natural beauty of the county. Numerous watershed lakes and farm ponds dot the landscape.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

The primary game species in Elk County are bobwhite quail, white-tailed deer, wild turkey, cottontail rabbit, fox squirrel, prairie chicken, and several species of waterfowl.

Nongame species are numerous because of the diverse habitat types in the county. Cropland, woodland, and grassland are intermixed throughout the county. This intermixture creates the desirable edge effect conducive to a variety of wildlife species. Establishing additional fringe areas generally increases the wildlife population.

Furbearers are common along many of the streams. They are trapped on a limited basis.

Numerous watershed lakes, farm ponds, and streams in Elk County provide good to excellent fishing (fig. 18). The species commonly caught are largemouth bass, bluegill, crappie, carp, channel cat, bullhead, and flathead catfish.

Figure 18.—A watershed lake in Elk County.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that

limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, grain sorghum, soybeans, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, switchgrass, indiangrass, grama, sunflowers, ragweed, and native legumes.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, hackberry, sycamore, cottonwood, black walnut, mulberry, pecan, hickory, ash, and willow. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, plum, fragrant sumac, autumn-olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, eastern redcedar, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are plum, dogwood, buckbrush, gooseberry, blackberry, and sumac.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, cattails, indigobush, prairie cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, lakes, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, mourning doves, meadowlarks, field sparrows, and cottontail rabbits.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, owls, hawks, thrushes, woodpeckers, squirrels, opossum, raccoon, and white-tailed deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, red-winged blackbirds, muskrat, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include coyotes, hawks, badgers, meadowlarks, and killdeer.

Technical assistance in planning wildlife areas and in determining the vegetation suitable for planting can be obtained from the local office of the Soil Conservation Service. Additional information and assistance can be obtained from the Kansas Fish and Game Commission and from the Cooperative Extension Service.

Engineering

John A. Eberwein, civil engineer, Soil Conservation Service, helped prepare this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development,

Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome;

moderate if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement, permeability, depth to a high water table or depth of standing water if the soil is subject to ponding, slope, susceptibility to flooding, subsidence of organic layers, and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 18.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 19). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

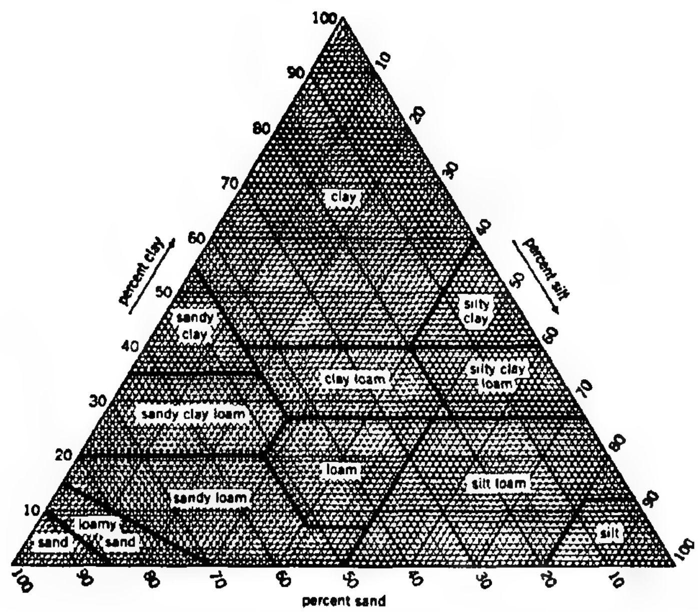


Figure 19.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content

of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume

change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17. Only saturated zones within a depth of about 6 feet are indicated.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 18 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Kansas Department of Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*5*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 19 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udoll (*Ud*, meaning humid, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiudolls (*Argi*, meaning argillic horizon, plus *udoll*, the suborder of the Mollisols that have a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Argiudolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, thermic Typic Argiudolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*4*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*5*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Bates Series

The Bates series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material that weathered from sandstone and silty and sandy shale. Slope ranges from 1 to 7 percent.

Bates soils are similar to Stephenville soils and are commonly adjacent to Dennis, Eram, Sogn, and Steedman soils. Stephenville soils have an E horizon and do not have a mollic epipedon. Dennis soils are more than 60 inches deep over bedrock. Dennis, Eram, and Steedman soils are in positions on the landscape

similar to those of the Bates soils. They have a subsoil that is more clayey than that of the Bates soils. Eram and Steedman soils are moderately deep over clayey shale. Sogn soils are less than 20 inches deep over limestone. They are generally above the Bates soils on the landscape.

Typical pedon of Bates fine sandy loam, 1 to 4 percent slopes, 2,150 feet east and 600 feet south of the northwest corner of sec. 29, T. 29 S., R. 13 E.

A—0 to 10 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable, hard; many fine roots; strongly acid; clear smooth boundary.

BA—10 to 14 inches; dark brown (10YR 3/3) loam, brown (10YR 4/3) dry; moderate fine subangular blocky structure; friable, hard; common fine roots; strongly acid; clear smooth boundary.

Bt—14 to 23 inches; dark yellowish brown (10YR 4/6) clay loam, yellowish brown (10YR 5/6) dry; common fine distinct strong brown (7.5YR 5/8) mottles; moderate fine subangular blocky structure; common fine roots; friable, hard; strongly acid; gradual smooth boundary.

BC—23 to 32 inches; dark yellowish brown (10YR 4/6) clay loam, brownish yellow (10YR 6/6) dry; few medium prominent yellowish red (5YR 5/8) and few fine distinct strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; friable, hard; few fine roots; few sandstone fragments less than 0.5 inch in size; strongly acid; clear wavy boundary.

Cr—32 inches; soft sandstone.

The thickness of the solum and the depth to sandstone range from 20 to 40 inches. The mollic epipedon is 8 to 24 inches thick. The content of sandstone fragments is less than 15 percent in any horizon. The solum ranges from slightly acid to strongly acid.

The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 2 or 3. It is dominantly fine sandy loam or loam, but the range includes silt loam. The Bt horizon has hue of 10YR or 7.5YR, value of 3 to 5 (4 to 6 dry), and chroma of 3 to 6. It is loam or clay loam.

Benfield Series

The Benfield series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in alkaline shale residuum. Slope ranges from 4 to 10 percent.

Benfield soils are similar to Florence soils and are commonly adjacent to Clime and Labette soils. They generally are lower on the landscape than the similar and adjacent soils. Florence soils are more than 40 inches deep over limestone. The content of chert fragments in their subsoil is more than 35 percent. Clime and Labette soils lack the chert fragments in the solum. Clime soils are calcareous. Labette soils are underlain by limestone.

Typical pedon of Benfield cherty silt loam, 4 to 10 percent slopes, 1,600 feet east of the southwest corner of sec. 32, T. 28 S., R. 9 E.

A—0 to 10 inches; very dark brown (10YR 2/2) cherty silt loam, dark grayish brown (10YR 4/2) dry; strong fine granular structure; friable, hard; many fine roots; about 30 percent chert fragments less than 3 inches in size; neutral; gradual wavy boundary.

BA—10 to 17 inches; very dark grayish brown (10YR 3/2) cherty silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; firm, very hard; common fine roots; about 30 percent chert fragments less than 3 inches in size; slightly acid; clear wavy boundary.

Bt1—17 to 24 inches; brown (10YR 4/3) silty clay loam, yellowish brown (10YR 5/4) dry; many fine distinct yellowish red (5YR 5/6) mottles; strong fine subangular blocky structure; firm, very hard; common fine roots; clay films on faces of most peds; few chert fragments less than 0.25 inch in size; neutral; gradual smooth boundary.

Bt2—24 to 30 inches; dark brown (10YR 4/3) and yellowish brown (10YR 5/6) silty clay, brown (10YR 5/3) and brownish yellow (10YR 6/6) dry; strong fine subangular blocky structure; very firm, very hard; few fine roots; clay films on faces of most peds; few chert fragments less than 0.25 inch in size; neutral; gradual smooth boundary.

BC—30 to 36 inches; grayish brown (2.5Y 5/2) cherty silty clay loam, light yellowish brown (2.5Y 6/4) dry; many fine and medium distinct olive yellow (2.5Y 6/6) mottles; weak fine blocky structure; firm, very hard; about 30 percent chert and limestone fragments; strong effervescence; mildly alkaline; gradual wavy boundary.

Cr—36 inches; calcareous, clayey shale.

The thickness of the solum and the depth to shale range from 20 to 40 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches. The content of coarse fragments less than 3 inches in size ranges from 0 to 30 percent in the solum. The depth to lime in any form other than concretions is more than 28 inches.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. It is dominantly cherty silt loam, but in some pedons it is cherty silty clay loam. It ranges from slightly acid to mildly alkaline. The Bt horizon has hue of 5YR to 2.5Y, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 6. It is silty clay loam, silty clay, cherty silty clay, or cherty silty clay loam. It ranges from neutral to moderately alkaline.

Catoosa Series

The Catoosa series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in limestone residuum. Slope ranges from 0 to 8 percent.

Catoosa soils are similar to Labette soils and are commonly adjacent to Kenoma and Sogn soils. Labette soils contain more clay in the subsoil than the Catoosa soils. Kenoma soils lack a BA horizon and are more than 40 inches deep over limestone. They are generally above the Catoosa soils on the landscape. Sogn soils are less than 20 inches deep over limestone. They are below the Catoosa soils on the landscape.

Typical pedon of Catoosa silt loam, 0 to 2 percent slopes, 1,250 feet east and 600 feet north of the southwest corner of sec. 27, T. 31 S., R. 11 E.

A—0 to 10 inches; dark brown (7.5YR 3/2) silt loam, brown (7.5YR 4/2) dry; strong fine granular structure; friable, hard; many fine roots; slightly acid; gradual smooth boundary.

BA—10 to 16 inches; dark reddish brown (5YR 3/4) silty clay loam, brown (7.5YR 4/4) dry; strong fine subangular blocky structure; friable, hard; common fine roots; medium acid; gradual smooth boundary.

Bt1—16 to 27 inches; dark reddish brown (5YR 3/4) silty clay loam, reddish brown (5YR 4/4) dry; strong fine subangular blocky structure; firm, hard; common fine roots; thin patchy clay films on faces of peds; few fine black stains; medium acid; gradual smooth boundary.

Bt2—27 to 34 inches; dark reddish brown (2.5YR 3/4) silty clay loam, moist or dry; strong fine subangular blocky structure; firm, very hard; common fine roots; thick continuous clay films on faces of peds; few fine black stains and concretions; medium acid; abrupt wavy boundary.

R—34 inches; limestone.

The thickness of the solum and the depth to limestone range from 20 to 40 inches. The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (3 to 5 dry), and chroma of 2. It is medium acid or slightly acid. The Bt horizon has hue of 7.5YR, 5YR, or 2.5YR, value of 3 or 4 (4 or 5 dry), and chroma of 2 to 6. It ranges from strongly acid to neutral.

Clime Series

The Clime series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in material weathered from calcareous, clayey shale. Slope ranges from 3 to 30 percent.

Clime soils are commonly adjacent to Martin and Sogn soils. Martin soils have an argillic horizon and are more than 40 inches deep over shale. They are generally below the Clime soils on side slopes. Sogn soils are less than 20 inches deep over limestone. They are generally above the Clime soils on the landscape.

Typical pedon of Clime silty clay, in an area of Clime-Sogn complex, 5 to 20 percent slopes, 1,600 feet west and 400 feet north of the southeast corner of sec. 11, T. 31 S., R. 10 E.

A—0 to 10 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; strong fine granular structure; firm, hard; many fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

Bw1—10 to 17 inches; very dark grayish brown (2.5Y 3/2) silty clay, grayish brown (2.5Y 5/2) dry; strong fine subangular blocky structure; very firm, very hard; common fine roots; common fine rounded lime concretions; slight effervescence; mildly alkaline; gradual smooth boundary.

Bw2—17 to 24 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; moderate fine blocky structure; very firm, very hard; few fine roots; common fine and medium rounded lime concretions; strong effervescence; mildly alkaline; gradual smooth boundary.

C—24 to 31 inches; olive (5Y 4/3) silty clay, pale olive (5Y 6/3) dry; many fine distinct light olive brown (2.5Y 5/6) mottles; massive; extremely firm, extremely hard; few fine roots; many fine shale fragments; common fine and medium, rounded lime concretions and few coarse, soft lime accumulations; strong effervescence; mildly alkaline; gradual smooth boundary.

Cr—31 inches; soft, calcareous, clayey shale.

The thickness of the solum ranges from 12 to 30 inches and the depth to shale from 20 to 40 inches. The depth to lime ranges from 0 to 10 inches. The mollic epipedon ranges from 6 to 20 inches in thickness. Reaction generally is mildly alkaline or moderately alkaline throughout the profile. In a few pedons, however, it is neutral to a depth of 10 inches.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. It is silty clay, silty clay loam, or the stony analogs of these textures. The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5 (4 to 7 dry), and chroma of 1 to 4. It is silty clay, clay, or silty clay loam. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 to 4. It is silty clay loam, silty clay, clay, or the shaly analogs of these textures.

Collinsville Series

The Collinsville series consists of shallow, well drained, moderately rapidly permeable soils on uplands. These soils formed in sandstone residuum. Slope ranges from 2 to 8 percent.

Collinsville soils are similar to Darnell soils and are commonly adjacent to Bates and Steedman soils. Darnell soils lack a mollic epipedon. Bates and Steedman soils are 20 to 40 inches deep over bedrock. Bates soils are above the Collinsville soils on the landscape, and Steedman soils are on the lower side slopes.

Typical pedon of Collinsville fine sandy loam, in an area of Collinsville-Bates fine sandy loams, 2 to 8 percent slopes, 200 feet east and 900 feet south of the northwest corner of sec. 29, T. 29 S., R. 13 E.

A—0 to 8 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; very friable, slightly hard; many fine roots; medium acid; clear smooth boundary.

C—8 to 14 inches; dark brown (10YR 4/3) fine sandy loam, brown (10YR 5/3) dry; massive; very friable, slightly hard; common fine roots; strongly acid; abrupt wavy boundary.

R—14 inches; hard sandstone.

The thickness of the solum and the depth to sandstone bedrock range from 4 to 20 inches. Reaction ranges from slightly acid to strongly acid throughout the profile. The content of sandstone fragments more than 3 inches in diameter ranges from 0 to 15 percent.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 2 or 3. The C horizon has hue of 10YR or 7.5YR, value of 3 or 4 (4 or 5 dry), and chroma of 3 or 4. It is fine sandy loam or loam. A few pedons have a Bw horizon. This horizon has colors similar to those of the C horizon. It has weak structure.

Darnell Series

The Darnell series consists of shallow, well drained, moderately rapidly permeable soils on uplands. These soils formed in sandstone residuum. Slope ranges from 1 to 35 percent.

Darnell soils are similar to Collinsville soils and are commonly adjacent to Niotaze, Steedman, and Stephenville soils. Collinsville soils have a mollic epipedon. Niotaze, Steedman, and Stephenville soils have an argillic horizon and are 20 to 40 inches deep over bedrock. Niotaze soils are on the lower side slopes, and Steedman and Stephenville soils are above the Darnell soils on the landscape.

Typical pedon of Darnell fine sandy loam, in an area of Stephenville-Darnell fine sandy loams, 1 to 6 percent slopes, 1,900 feet west and 1,400 feet south of the northeast corner of sec. 7, T. 29 S., R. 13 E.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) fine sandy loam, brown (10YR 5/3) dry; weak fine granular structure; very friable, slightly hard; many fine roots; slightly acid; clear smooth boundary.

Bw—4 to 12 inches; dark yellowish brown (10YR 4/4) gravelly fine sandy loam, light yellowish brown (10YR 6/4) dry; weak fine granular structure; very friable, slightly hard; common fine roots; about 20 percent sandstone fragments less than 1 inch in diameter; slightly acid; abrupt wavy boundary.

Cr—12 inches; soft sandstone.

The thickness of the solum and the depth to sandstone bedrock range from 10 to 20 inches. Reaction ranges from neutral to strongly acid throughout the profile.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4 (4 or 5 dry), and chroma of 2 to 4. The Bw horizon has hue of 5YR to 10YR, value of 3 to 6 (5 to 7 dry), and chroma of 3 to 6. It is gravelly fine sandy loam, fine sandy loam, or loam. The content of sandstone fragments less than 3 inches in diameter ranges from 0 to 20 percent.

Dennis Series

The Dennis series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in colluvium or material weathered from shale. Slope ranges from 1 to 7 percent.

Dennis soils are similar to Eram, Kenoma, and Newtonia soils and are commonly adjacent to Catoosa, Eram, and Kenoma soils. Eram soils are 20 to 40 inches deep over clayey shale. They are on side slopes above or below the Dennis soils. Kenoma soils lack a BA horizon. They are on ridgetops. Newtonia soils are less clayey in the upper part of the subsoil than the Dennis soils. Catoosa soils are 20 to 40 inches deep over limestone. They are on ridgetops.

Typical pedon of Dennis silt loam, 4 to 7 percent slopes, 100 feet south and 500 feet east of the northwest corner of sec. 27, T. 30 S., R. 12 E.

A—0 to 13 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; strong fine and medium granular structure; friable, hard; many fine roots; medium acid; clear smooth boundary.

BA—13 to 20 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 4/3) dry; few fine prominent yellowish red (5YR 4/6) mottles; strong fine subangular blocky structure; friable, hard; few medium black stains; many fine roots; medium acid; gradual smooth boundary.

Bt1—20 to 29 inches; dark brown (10YR 4/3) silty clay, brown (10YR 5/3) dry; common fine prominent yellowish red (5YR 4/6) mottles; strong fine subangular blocky structure; very firm, very hard; common fine roots; few black stains; clay films on faces of most peds; strongly acid; gradual smooth boundary.

Bt2—29 to 38 inches; dark yellowish brown (10YR 4/4) silty clay, yellowish brown (10YR 5/4) dry; few fine distinct dark gray (10YR 4/1) and common fine prominent yellowish red (5YR 4/6) mottles; moderate fine and medium subangular blocky structure; very firm, extremely hard; common fine roots; clay films on faces of most peds; common medium black stains and rounded black concretions; strongly acid; gradual smooth boundary.

Bt3—38 to 51 inches; yellowish brown (10YR 5/6) silty clay, brownish yellow (10YR 6/6) dry; many medium distinct dark grayish brown (10YR 4/2) and few fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; very firm, extremely hard; few fine roots; clay films on faces of most peds; few medium rounded black concretions; strongly acid; diffuse smooth boundary.

BC—51 to 60 inches; strong brown (7.5YR 5/6) silty clay, reddish yellow (7.5YR 6/6) dry; common medium distinct dark grayish brown (10YR 4/2) mottles; weak fine blocky structure; extremely firm, extremely hard; few fine roots; common medium rounded black concretions and stains; slightly acid.

The solum is more than 60 inches thick. The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 2 or 3. It is dominantly silt loam, but the range includes silty clay loam and loam. This horizon is strongly acid or medium acid. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5 (5 or 6 dry), and chroma of 3 to 6. It is silty clay loam, silty clay, or clay. It ranges from slightly acid to strongly acid.

Dennis silty clay loam, 3 to 7 percent slopes, eroded, is a taxadjunct because it lacks a mollic epipedon and is slightly less acid than is defined as the range for the series. These differences, however, do not alter the usefulness or behavior of the soil.

Dwight Series

The Dwight series consists of deep, moderately well drained, very slowly permeable, sodic soils on uplands. These soils formed in clayey sediments or in limestone residuum. Slope ranges from 0 to 3 percent.

Dwight soils are similar to Woodson soils and are commonly adjacent to Clime, Florence, and Labette soils. The similar and adjacent soils do not have a natric horizon. Woodson soils have a surface layer that is thicker than that of the Dwight soils. The calcareous Clime soils are 20 to 40 inches deep over shale and are on side slopes. Florence soils are on side slopes below the Dwight soils. Their content of angular chert fragments is more than 35 percent. Labette soils are 20 to 40 inches deep over limestone. They are in landscape positions similar to those of the Dwight soils.

Typical pedon of Dwight silt loam, in an area of Labette-Dwight complex, 0 to 3 percent slopes, 2,200 feet east and 1,400 feet south of the northwest corner of sec. 30, T. 29 S., R. 10 E.

A—0 to 4 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine granular structure; gray silt coatings in the lower 2 inches; many fine roots; very friable, slightly hard; medium acid; abrupt smooth boundary.

Bt1—4 to 15 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; weak medium columnar structure parting to moderate fine subangular blocky; extremely firm, extremely hard; the upper boundary marked by rounded caps coated with gray silt grains; common fine roots along faces of peds; clay films on faces of most peds; slightly acid; clear smooth boundary.

Bt2—15 to 27 inches; dark brown (10YR 3/3) silty clay, brown (10YR 4/3) dry; moderate fine blocky structure; extremely firm, extremely hard; few fine roots along faces of peds; clay films on faces of peds; few slickensides; few medium rounded black concretions; moderately alkaline; gradual smooth boundary.

BC—27 to 42 inches; dark yellowish brown (10YR 4/4) silty clay, yellowish brown (10YR 5/4) dry; weak fine blocky structure; extremely firm, extremely hard; few fine rounded soft accumulations of lime; slight effervescence; moderately alkaline; abrupt wavy boundary.

R—42 inches; hard limestone.

The thickness of the solum ranges from 30 to 55 inches. The depth to hard limestone or shale ranges from 40 to 60 inches. The mollic epipedon is 15 to 30 inches thick.

The A horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 or 2. It ranges from medium acid to neutral. The Bt horizon has hue of 10YR or 7.5YR, value of 2 to 4 (3 to 5 dry), and chroma of 1 to 3. It is clay or silty clay. It ranges from slightly acid to moderately alkaline. In some pedons it has gypsum crystals in the lower part.

Eram Series

The Eram series consists of moderately deep, moderately well drained, slowly permeable soils on uplands. These soils formed in shale residuum. Slope ranges from 1 to 7 percent.

Eram soils are similar to Dennis, Fiat, Martin, and Steedman soils and are commonly adjacent to Dennis, Kenoma, Sogn, and Steedman soils. Fiat soils are underlain by limestone. Dennis, Kenoma, and Martin soils are more than 40 inches deep over bedrock. Dennis and Martin soils are mainly below the Eram soils on the landscape. Kenoma soils are on broad ridgetops. Sogn soils are less than 20 inches deep over limestone.

They are mainly above the Eram soils on the landscape. Steedman soils do not have a mollic epipedon.

Typical pedon of Eram silt loam, 1 to 4 percent slopes, 100 feet south and 300 feet west of the northeast corner of sec. 26, T. 28 S., R. 9 E.

A—0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; strong medium granular structure; friable, hard; many fine roots; slightly acid; clear smooth boundary.

BA—10 to 15 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 4/3) dry; moderate fine subangular blocky structure; firm, hard; many fine roots; few sandstone fragments less than 0.5 inch in size; slightly acid; gradual smooth boundary.

Bt—15 to 23 inches; grayish brown (2.5Y 5/2) silty clay, light yellowish brown (2.5Y 6/4) dry; many fine distinct olive yellow (2.5Y 6/6) mottles; moderate fine subangular blocky structure; thin continuous clay films on faces of most peds; firm, very hard; few black stains; common fine roots; few sandstone fragments less than 0.25 inch in size; medium acid; clear smooth boundary.

BC—23 to 33 inches; grayish brown (2.5Y 5/2) silty clay, light brownish gray (2.5Y 6/2) dry; common fine distinct olive yellow (2.5Y 6/6) mottles; weak fine blocky structure; few shale fragments; few fine roots; very firm, very hard; few black stains; medium acid; gradual wavy boundary.

Cr—33 inches; shale.

The thickness of the solum and the depth to shale range from 20 to 40 inches. The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 2 or 3. It is dominantly silt loam or silty clay loam, but the range includes clay and clay loam. This horizon is slightly acid or medium acid. The Bt horizon has hue of 7.5YR to 2.5Y, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 4. It ranges from strongly acid to neutral. It is clay loam, silty clay loam, or silty clay. In some pedons seams of lime are in the Cr horizon.

Fiat Series

The Fiat series consists of moderately deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in material weathered from limestone and shale. Slope ranges from 1 to 3 percent.

Fiat soils are similar to Eram and Martin soils and are commonly adjacent to Catoosa, Eram, and Sogn soils. The moderately well drained Eram soils are underlain by clayey shale. Martin soils are more than 40 inches deep over bedrock. The well drained Catoosa soils have a silty subsoil. They are in landscape positions similar to those of the Fiat soils. Sogn soils are less than 20 inches deep over limestone. They are below the Fiat soils on the landscape.

Typical pedon of Fiat silty clay loam, 1 to 3 percent slopes, 2,250 feet east and 1,800 feet north of the southwest corner of sec. 35, T. 29 S., R. 11 E.

A—0 to 11 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; strong fine granular structure; firm, hard; many fine roots; medium acid; gradual smooth boundary.

Bt1—11 to 24 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; few fine prominent yellowish red (5YR 5/8) mottles; strong fine subangular blocky structure; very firm, extremely hard; common fine roots; slightly acid; clear smooth boundary.

Bt2—24 to 30 inches; dark grayish brown (10YR 4/2) silty clay, grayish brown (10YR 5/2) dry; many medium distinct olive brown (2.5Y 4/4) and few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; very firm, extremely hard; few fine roots; neutral; abrupt wavy boundary.

R—30 inches; hard limestone.

The thickness of the solum and the depth to limestone bedrock range from 20 to 40 inches. The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. It is slightly acid or medium acid. The Bt horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 or 2. It is silty clay or clay. It is slightly acid or neutral.

Florence Series

The Florence series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in cherty limestone residuum. Slope ranges from 2 to 12 percent.

Florence soils are similar to Benfield soils and are commonly adjacent to Clime, Dwight, Labette, and Martin soils. Benfield soils are 20 to 40 inches deep over shale. The content of coarse fragments in their subsoil is less than 35 percent. The content of chert fragments in the solum of Clime, Dwight, Labette, and Martin soils is less than 10 percent. The calcareous Clime soils are 20 to 40 inches deep over shale. They are on side slopes below the Florence soils. Dwight soils are on ridgetops. Labette soils are 20 to 40 inches deep over limestone. They are on ridgetops above the Florence soils. Martin soils are on foot slopes below the Florence soils.

Typical pedon of Florence cherty silt loam, in an area of Florence-Martin complex, 2 to 12 percent slopes, 1,500 feet east of the southwest corner of sec. 34, T. 28 S., R. 8 E.

A1—0 to 6 inches; very dark brown (10YR 2/2) cherty silt loam, dark grayish brown (10YR 4/2) dry; strong fine granular structure; very friable, hard; about 20

percent chert fragments 0.25 inch to 2 inches in size; many fine roots; slightly acid; clear wavy boundary.

A2—6 to 12 inches; very dark brown (10YR 2/2) very cherty silt loam, very dark grayish brown (10YR 3/2) dry; strong fine granular structure; friable, hard; about 50 percent chert fragments 0.25 inch to 3 inches in size; many fine roots; slightly acid; gradual smooth boundary.

BA—12 to 18 inches; very dark grayish brown (10YR 3/2) extremely cherty silty clay loam, dark grayish brown (10YR 4/2) dry; strong fine granular structure; firm, hard; about 80 percent chert fragments 0.5 inch to 3 inches in size; common fine roots; slightly acid; clear smooth boundary.

Bt1—18 to 32 inches; dark brown (7.5YR 4/4) and dark red (2.5YR 3/6) extremely cherty silty clay, moist or dry; moderate fine and medium subangular blocky structure; very firm, very hard; about 80 percent chert fragments as much as 3 inches in size; few fine roots; slightly acid; gradual irregular boundary.

Bt2—32 to 49 inches; dark red (2.5YR 3/6) extremely cherty clay, moist or dry; common medium prominent dark brown (7.5YR 4/4) mottles; moderate fine and medium subangular blocky structure; extremely firm, extremely hard; about 80 percent chert fragments as much as 4 inches in size; some chert fragments as much as 7 inches in size in the lower part; few fine roots; slightly acid; abrupt wavy boundary.

R—49 inches; cherty limestone.

The thickness of the solum and the depth to limestone range from 40 to 60 inches. The mollic epipedon ranges from 10 to 20 inches in thickness.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. It is dominantly cherty silt loam, but the range includes cherty silty clay loam, silt loam, and silty clay loam. The horizon ranges from medium acid to neutral. The Bt horizon has hue of 7.5YR, 5YR, or 2.5YR, value of 3 to 5 (4 or 5 dry), and chroma of 3 to 6. It ranges from slightly acid to mildly alkaline. The content of chert in this horizon ranges from 50 to 85 percent.

Ivan Series

The Ivan series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in calcareous, silty alluvium. Slope ranges from 0 to 2 percent.

Ivan soils are similar to Mason and Verdigris soils and are commonly adjacent to Martin and Mason soils. Mason soils have an argillic horizon. They are subject to rare flooding and are on terraces above the Ivan soils. Verdigris soils are noncalcareous. Martin soils have a clayey subsoil. They are on foot slopes above the Ivan soils.

Typical pedon of Ivan silt loam, occasionally flooded, 1,300 feet west and 1,200 feet south of the northeast corner of sec. 16, T. 29 S., R. 9 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable, hard; few fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

A1—8 to 19 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; very friable, hard; few worm casts and pores; few fine roots; slight effervescence; moderately alkaline; gradual smooth boundary.

A2—19 to 33 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable, hard; few fine roots; common fine and very fine pores; slight effervescence; moderately alkaline; gradual smooth boundary.

AC—33 to 60 inches; dark brown (10YR 3/3) silt loam, brown (10YR 4/3) dry; massive; friable, very hard; common fine and very fine pores; strong effervescence; moderately alkaline.

The solum ranges from 24 to more than 60 inches in thickness. The depth to lime ranges from 0 to 10 inches.

The A and AC horizons have hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 or 2. They are dominantly silt loam, but in places they are silty clay loam. Some pedons have a C horizon. This horizon has hue of 10YR or 7.5YR, value of 3 to 5 (5 to 7 dry), and chroma of 2 or 3. It is loam, silt loam, or silty clay loam. Some pedons have strata containing more clay or more sand below a depth of 40 inches. Also, some pedons have a buried A horizon below a depth of 40 inches.

Kenoma Series

The Kenoma series consists of deep, moderately well drained, very slowly permeable soils on uplands or high terraces. These soils formed in old alluvial sediments or shale residuum. Slope ranges from 1 to 3 percent.

Kenoma soils are similar to Dennis soils and are commonly adjacent to Catoosa, Dennis, Eram, and Woodson soils. Catoosa, Dennis, and Eram soils have a BA horizon. Catoosa and Eram soils are 20 to 40 inches deep over bedrock. Catoosa soils are in the slightly lower areas. Eram soils are mainly in the more sloping areas below the Kenoma soils. Woodson soils are less sloping than the Kenoma soils and have a grayer subsoil.

Typical pedon of Kenoma silt loam, 1 to 3 percent slopes, 2,500 feet north and 100 feet east of the southwest corner of sec. 14, T. 29 S., R. 10 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; gray coatings in the lower 3 inches; moderate fine granular structure; friable, hard; many fine roots; slightly acid; abrupt smooth boundary.

Bt—8 to 29 inches; dark brown (10YR 3/3) silty clay, brown (10YR 4/3) dry; few fine faint dark grayish brown (10YR 4/2) mottles; moderate fine subangular blocky structure; very firm, extremely hard; clay films on faces of most peds; common fine roots; slightly acid; gradual smooth boundary.

BC—29 to 50 inches; dark yellowish brown (10YR 4/4) silty clay, yellowish brown (10YR 5/4) dry; few fine distinct dark gray (10YR 4/1) and few fine prominent yellowish red (5YR 4/6) mottles; weak fine blocky structure; extremely firm, extremely hard; few fine black stains; mildly alkaline; gradual smooth boundary.

C—50 to 60 inches; yellowish brown (10YR 5/6) silty clay, brownish yellow (10YR 6/6) dry; common medium distinct light brownish gray (10YR 6/2) and brown (10YR 5/3) mottles; weak fine and medium blocky fragments; very firm, very hard; common black stains and streaks; few shale fragments less than 0.25 inch in size; mildly alkaline.

The thickness of the solum ranges from 30 to 60 inches. In some pedons the content of waterworn chert gravel below the A horizon is as much as 20 percent. A few pedons have limestone or shale at a depth of 40 to 60 inches.

The A horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 to 3. It is dominantly silt loam, but in some pedons it is silty clay loam. It ranges from strongly acid to slightly acid. The boundary between the A and Bt horizons is abrupt or clear. The upper part of the Bt horizon has hue of 10YR or 7.5YR, value of 2 or 3 (4 or 5 dry), and chroma of 2 or 3. The lower part has hue of 10YR or 7.5YR, value of 3 to 6 (4 to 7 dry), and chroma of 2 to 6. The Bt horizon is silty clay or clay that has a clay content of 40 to 60 percent. This horizon ranges from medium acid to mildly alkaline.

Labette Series

The Labette series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in material weathered from interbedded limestone and shale. Slope ranges from 0 to 8 percent.

Labette soils are similar to Catoosa and Martin soils and are commonly adjacent to Dwight, Florence, and Sogn soils. Catoosa soils have a silty subsoil. Martin soils are more than 40 inches deep over limestone. Dwight soils have a natric horizon and have an A horizon that is thinner than that of the Labette soils. Generally, they are nearly level and are above the Labette soils on ridgetops. Florence soils are on side slopes below the Labette soils. The content of chert fragments in their subsoil is more than 35 percent. Sogn soils are less than 20 inches deep over limestone. They are below the Labette soils on the landscape.

Typical pedon of Labette silty clay loam, in an area of Labette-Dwight complex, 0 to 3 percent slopes, 1,300 feet east and 1,100 feet north of the southwest corner of sec. 20, T. 29 S., R. 9 E.

A—0 to 9 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; strong fine and medium granular structure; friable, hard; many fine roots; slightly acid; clear smooth boundary.

BA—9 to 14 inches; dark brown (7.5YR 3/2) silty clay loam, brown (7.5YR 4/2) dry; strong fine subangular blocky structure; firm, very hard; many fine roots; slightly acid; gradual smooth boundary.

Bt1—14 to 20 inches; dark reddish brown (5YR 3/3) silty clay, moist or dry; strong fine subangular blocky structure; very firm, very hard; common fine roots; thin patchy clay films on faces of peds; few fine black concretions; slightly acid; gradual smooth boundary.

Bt2—20 to 30 inches; dark reddish brown (5YR 3/4 and 3/2) silty clay, moist or dry; moderate fine subangular blocky structure; very firm, extremely hard; common fine roots; thick continuous clay films on faces of peds; common fine black stains and black concretions; neutral; abrupt wavy boundary.

R—30 inches; hard limestone.

The thickness of the solum and the depth to limestone range from 20 to 40 inches. The mollic epipedon ranges from 10 to 20 inches in thickness.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. It is silty clay loam or silt loam. It is medium acid or slightly acid. The Bt horizon has hue of 7.5YR or 5YR, value of 3 to 5 (4 to 6 dry), and chroma of 2 to 6. It ranges from slightly acid to mildly alkaline. It is silty clay loam or silty clay that has a clay content of 35 to 50 percent.

Lanton Series

The Lanton series consists of deep, somewhat poorly drained, moderately slowly permeable soils on flood plains. These soils formed in alluvium. Slope ranges from 0 to 2 percent.

Lanton soils are similar to Osage and Verdigris soils and commonly are adjacent to those soils. The poorly drained Osage soils are clayey within 20 inches of the surface. They are in swales and backwater areas. The well drained Verdigris soils generally are not mottled. They are adjacent to stream channels.

Typical pedon of Lanton silty clay loam, occasionally flooded, 1,200 feet east and 150 feet south of the northwest corner of sec. 34, T. 31 S., R. 13 E.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable, hard; few fine roots; neutral; clear smooth boundary.

A1—7 to 14 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable, very hard; few fine roots; slightly acid; gradual smooth boundary.

A2—14 to 26 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; strong fine subangular blocky structure; firm, very hard; few fine roots; slightly acid; gradual smooth boundary.

A3—26 to 36 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; very firm, very hard; slightly acid; gradual smooth boundary.

Cg—36 to 60 inches; dark grayish brown (10YR 4/2) silty clay, grayish brown (10YR 5/2) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine blocky fragments; few black stains; very firm, extremely hard; neutral.

The mollic epipedon is more than 24 inches thick. The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. It is dominantly silty clay loam, but in some pedons it is silt loam. The Cg horizon has hue of 10YR or 2.5Y, value of 4 or 5 (5 or 6 dry), and chroma of 1 or 2. It is silty clay loam or silty clay.

Martin Series

The Martin series consists of deep, moderately well drained, slowly permeable soils on uplands or foot slopes. These soils formed in colluvium or clayey shale residuum. Slope ranges from 1 to 11 percent.

Martin soils are similar to Eram, Fiat, and Labette soils and are commonly adjacent to Clime, Eram, and Florence soils. Eram, Fiat, and Labette soils are 20 to 40 inches deep over bedrock. They generally are on ridgetops and the upper side slopes above the Martin soils. The calcareous Clime soils are 20 to 40 inches deep over shale and do not have an argillic horizon. They are on the upper side slopes. Florence soils are generally above the Martin soils on the landscape. The content of chert in their subsoil is more than 35 percent.

Typical pedon of Martin silty clay loam, 4 to 7 percent slopes, 2,400 feet east and 500 feet south of the northwest corner of sec. 17, T. 29 S., R. 9 E.

A—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; strong fine and medium granular structure; firm, hard; many fine roots; slightly acid; gradual smooth boundary.

BA—9 to 14 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; strong fine subangular blocky structure; firm, very hard; many fine roots; slightly acid; clear smooth boundary.

Bt1—14 to 24 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; very firm, extremely hard; common fine roots; clay films on faces of peds; neutral; gradual smooth boundary.

Bt2—24 to 32 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; few medium distinct dark gray (10YR 4/1) and few fine distinct light olive brown (2.5Y 5/6) mottles; weak medium blocky structure; very firm, extremely hard; few fine roots; few black stains and rounded black concretions; clay films on faces of peds; neutral; gradual smooth boundary.

BC—32 to 55 inches; grayish brown (10YR 5/2) silty clay, light brownish gray (10YR 6/2) dry; few medium distinct light olive brown (2.5Y 5/6) mottles; weak medium blocky structure; very firm, extremely hard; few fine roots; few black stains; mildly alkaline; gradual smooth boundary.

C—55 to 60 inches; light brownish gray (10YR 6/2) silty clay, light gray (10YR 7/2) dry; common medium distinct yellowish brown (10YR 5/6) mottles; weak fine blocky fragments; extremely firm, extremely hard; few lime concretions and soft masses of lime; mildly alkaline; slight effervescence.

The solum ranges from 40 to 60 inches in thickness. The depth to shale is more than 40 inches. The mollic epipedon is 24 to 36 inches thick.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. It is dominantly silty clay loam, but in some pedons it is silty clay. It is medium acid or slightly acid. The Bt horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 or 2. It is clay or silty clay that has a clay content of 40 to 55 percent. It ranges from medium acid to neutral.

Mason Series

The Mason series consists of deep, well drained, moderately slowly permeable soils on stream terraces. These soils formed in alluvium. Slope ranges from 0 to 2 percent.

Mason soils are similar to Ivan, Newtonia, and Verdigris soils and are commonly adjacent to Ivan and Verdigris soils. Verdigris soils and the calcareous Ivan soils do not have an argillic horizon. They are on flood plains. Newtonia soils have a subsoil that is redder than that of the Mason soils. They are on high terraces.

Typical pedon of Mason silt loam, 800 feet east and 200 feet north of the southwest corner of sec. 30, T. 29 S., R. 10 E.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry;

moderate fine granular structure; very friable, slightly hard; common fine roots; neutral; clear smooth boundary.

A—7 to 14 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 4/3) dry; strong fine and medium granular structure; friable, hard; few fine roots; neutral; gradual smooth boundary.

Bt1—14 to 25 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 4/3) dry; strong fine subangular blocky structure; firm, hard; few fine roots; slightly acid; gradual smooth boundary.

Bt2—25 to 46 inches; brown (10YR 4/3) silty clay loam, yellowish brown (10YR 5/4) dry; strong fine subangular blocky structure; firm, very hard; thin clay films on faces of most peds; slightly acid; gradual smooth boundary.

C—46 to 60 inches; dark yellowish brown (10YR 4/4) silty clay loam, yellowish brown (10YR 5/4) dry; massive; firm, very hard; common fine threadlike accumulations of powdery lime; mildly alkaline; strong effervescence.

The thickness of the solum ranges from 40 to more than 60 inches. The mollic epipedon is more than 20 inches thick.

The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 2 or 3. It is dominantly silt loam, but the range includes loam and silty clay loam. This horizon ranges from medium acid to neutral. The Bt horizon has hue of 10YR or 7.5YR, value of 3 or 4 (4 or 5 dry), and chroma of 2 to 4. It is medium acid or slightly acid.

Newtonia Series

The Newtonia series consists of deep, well drained, moderately permeable soils on high terraces. These soils formed in silty and clayey sediments. Slope ranges from 1 to 3 percent.

Newtonia soils are similar to Dennis and Mason soils and commonly are adjacent to those soils. The moderately well drained Dennis soils are more clayey in the upper part of the subsoil than the Newtonia soils. Also, they are generally higher on the landscape. Mason soils have a subsoil that is less red than that of the Newtonia soils. They are on rarely flooded terraces below the Newtonia soils.

Typical pedon of Newtonia silt loam, 1 to 3 percent slopes, 2,200 feet north and 1,000 feet west of the southeast corner of sec. 12, T. 30 S., R. 10 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 4/3) dry; moderate fine granular structure; very friable, slightly hard; common fine roots; slightly acid; clear smooth boundary.

A—8 to 12 inches; dark brown (7.5YR 3/2) silt loam, brown (7.5YR 4/2) dry; strong fine granular structure; friable, hard; common fine roots; slightly acid; gradual smooth boundary.

BA—12 to 18 inches; dark reddish brown (5YR 3/4) silty clay loam, reddish brown (5YR 5/4) dry; strong fine subangular blocky structure; firm, hard; common fine roots; slightly acid; gradual smooth boundary.

Bt1—18 to 26 inches; yellowish red (5YR 4/6) silty clay loam, moist or dry; few fine distinct dark reddish brown (5YR 3/4) mottles; strong fine subangular blocky structure; firm, very hard; few black stains; clay films on faces of peds; medium acid; clear wavy boundary.

Bt2—26 to 48 inches; yellowish red (5YR 4/6) silty clay loam, moist or dry; few medium prominent dark yellowish brown (10YR 4/4) mottles; strong fine subangular blocky structure; firm, hard; common black stains; clay films on faces of peds; few pebbles less than 0.5 inch in size; medium acid; gradual smooth boundary.

BC—48 to 60 inches; yellowish red (5YR 4/6) silty clay, moist or dry; common medium prominent dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; very firm, very hard; common black stains; about 10 percent pebbles less than 1 inch in size; slightly acid.

The solum is more than 60 inches thick. The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (4 or 5 dry), and chroma of 2 or 3. It is dominantly silt loam, but in some pedons it is silty clay loam. It is slightly acid or medium acid. The Bt horizon has hue of 5YR or 2.5YR, value of 3 or 4 (4 or 5 dry), and chroma of 3 to 6. It is silty clay loam in the upper part and silty clay loam or silty clay in the lower part. It is medium acid or strongly acid.

Niotaze Series

The Niotaze series consists of moderately deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in material weathered from shale interbedded with sandstone. Slope ranges from 6 to 35 percent.

Niotaze soils are similar to Steedman soils and are commonly adjacent to Darnell, Prue, Steedman, and Stephenville soils. Steedman soils lack an E horizon. They are mainly above the Niotaze soils on the landscape. Darnell soils are less than 20 inches deep over sandstone. They are on ridgetops and the upper side slopes. Prue and Stephenville soils have a loamy subsoil. Prue soils are more than 60 inches deep over bedrock. They are on foot slopes below the Niotaze soils. Stephenville soils are on ridgetops above the Niotaze soils.

Typical pedon of Niotaze cobbly fine sandy loam, in an area of Niotaze-Darnell complex, 6 to 35 percent slopes,

2,300 feet south and 1,300 feet west of the northeast corner of sec. 32, T. 31 S., R. 13 E.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) cobbly fine sandy loam, brown (10YR 5/3) dry; strong fine granular structure; very friable, slightly hard; many fine roots; about 20 percent sandstone fragments less than 3 inches in size; medium acid; clear smooth boundary.

E—3 to 7 inches; pale brown (10YR 6/3) fine sandy loam, very pale brown (10YR 7/3) dry; few medium distinct brownish yellow (10YR 6/8) mottles; weak fine granular structure; very friable, hard; few fine pores; common fine roots; about 10 percent sandstone fragments less than 3 inches in size; strongly acid; clear smooth boundary.

2Bt1—7 to 13 inches; strong brown (7.5YR 5/6) silty clay, reddish yellow (7.5YR 6/6) dry; strong fine blocky structure; firm, very hard; clay films on faces of peds; thin stone line at the lower boundary; few fine roots; very strongly acid; clear smooth boundary.

2Bt2—13 to 21 inches; light olive brown (2.5Y 5/4) silty clay, light yellowish brown (2.5Y 6/4) dry; common medium prominent red (2.5YR 5/6) mottles; strong fine blocky structure; very firm, very hard; clay films on faces of most peds; few fine roots; very strongly acid; gradual smooth boundary.

2BC—21 to 30 inches; grayish brown (2.5Y 5/2) clay, light brownish gray (2.5Y 6/2) dry; common medium prominent yellowish brown (10YR 5/6) and few medium prominent red (2.5YR 5/6) mottles; weak fine and medium blocky structure; few slickensides; very firm, very hard; few fine roots; very strongly acid; gradual wavy boundary.

2Cr—30 inches; interbedded clayey shale and sandstone.

The thickness of the solum and the depth to shale range from 20 to 40 inches. Sandstone rocks on the surface range from 3 to 10 inches in size.

The A horizon has hue of 10YR, value of 2 to 4 (4 to 6 dry), and chroma of 1 to 3. It is dominantly cobbly fine sandy loam, but the range includes loam, silty clay loam, stony fine sandy loam, cobbly loam, and stony loam. This horizon is medium acid or strongly acid. The E horizon has hue of 10YR or 7.5YR, value of 4 to 6 (5 to 7 dry), and chroma of 2 or 3. The texture and reaction of this horizon are similar to those of the A horizon. The content of sandstone fragments in the A and E horizons is less than 35 percent. The Bt horizon has hue of 2.5YR to 2.5Y, value of 3 to 5 (4 to 6 dry), and chroma of 3 to 6. It is silty clay loam, silty clay, or clay that has clay content of 35 to 55 percent. This horizon ranges from slightly acid to very strongly acid.

Osage Series

The Osage series consists of deep, poorly drained, very slowly permeable soils on flood plains. These soils formed in clayey alluvium. Slope is 0 to 1 percent.

Osage soils are similar to Lanton soils and are commonly adjacent to Lanton and Mason soils. The somewhat poorly drained Lanton soils are silty in the upper part of the subsoil. They are on the slightly higher flood plains. The well drained Mason soils have an argillic horizon. They are on rarely flooded terraces.

Typical pedon of Osage silty clay loam, occasionally flooded, 900 feet north and 2,300 feet west of the southeast corner of sec. 21, T. 31 S., R. 13 E.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; firm, hard; neutral; clear smooth boundary.

A—7 to 11 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; firm, very hard; few fine roots; neutral; gradual smooth boundary.

Bg1—11 to 18 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; few fine distinct olive brown (2.5Y 4/4) mottles; moderate fine and medium blocky structure; very firm, very hard; few fine roots; neutral; gradual smooth boundary.

Bg2—18 to 32 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; common fine faint very dark grayish brown (2.5Y 3/2) and few fine distinct strong brown (7.5YR 5/8) mottles; moderate fine blocky structure; very firm, extremely hard; neutral; diffuse smooth boundary.

BCg—32 to 46 inches; dark gray (10YR 4/1) silty clay, gray (10YR 5/1) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium blocky structure; very firm, extremely hard; mildly alkaline; diffuse smooth boundary.

Cg—46 to 60 inches; grayish brown (10YR 5/2) silty clay, light brownish gray (10YR 6/2) dry; common medium distinct dark yellowish brown (10YR 4/4) mottles; massive; extremely firm, extremely hard; mildly alkaline.

The solum is more than 40 inches thick. The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. It is dominantly silty clay loam, but in some pedons it is silty clay. It ranges from strongly acid to neutral. The Bg horizon has hue of 10YR or 2.5Y, value of 3 (4 dry), and chroma of less than 2. It ranges from medium acid to mildly alkaline.

Prue Series

The Prue series consists of deep, moderately well drained, moderately slowly permeable soils on uplands. These soils formed in colluvium or in material weathered

from interbedded sandstone and shale. Slope ranges from 2 to 6 percent.

Prue soils are commonly adjacent to Mason and Niotaze soils. Mason soils have a silty subsoil. They are on stream terraces. Niotaze soils are moderately deep over shale and have a clayey subsoil. They are on the steeper slopes above the Prue soils.

Typical pedon of Prue fine sandy loam, 2 to 6 percent slopes, 550 feet west and 200 feet south of the northeast corner of sec. 8, T. 31 S., R. 13 E.

A—0 to 11 inches; very dark grayish brown (10YR 3/2) fine sandy loam, brown (10YR 5/3) dry; moderate fine granular structure; very friable, slightly hard; few fine roots; strongly acid; clear wavy boundary.

BA—11 to 16 inches; dark brown (10YR 4/3) loam, brownish yellow (10YR 6/6) dry; few medium prominent reddish brown (5YR 4/4) mottles; moderate fine subangular blocky structure; very friable, slightly hard; few fine roots; common fine and very fine pores; strongly acid; gradual smooth boundary.

Bt1—16 to 26 inches; yellowish brown (10YR 5/4) clay loam, brownish yellow (10YR 6/6) dry; few medium prominent yellowish red (5YR 5/6) mottles; moderate fine subangular blocky structure; friable, hard; few fine roots; common very fine pores; strongly acid; gradual smooth boundary.

Bt2—26 to 34 inches; yellowish brown (10YR 5/6) clay loam, brownish yellow (10YR 6/6) dry; common medium prominent yellowish red (5YR 5/8) mottles; few streaks of very dark grayish brown (10YR 3/2) material; moderate fine subangular blocky structure; friable, hard; thin patchy clay films on faces of peds; few fine roots; common very fine pores; strongly acid; clear wavy boundary.

Bt3—34 to 48 inches; pale brown (10YR 6/3) clay loam, very pale brown (10YR 7/3) dry; many coarse prominent reddish yellow (7.5YR 6/8) mottles; moderate fine blocky structure; friable, hard; thin patchy clay films on faces of peds; few fine roots; common very fine pores; many distinct light gray (10YR 7/2) skeletans; strongly acid; clear wavy boundary.

2BC—48 to 60 inches; yellowish brown (10YR 5/6) silty clay loam, brownish yellow (10YR 6/8) dry; common medium distinct brown (10YR 5/3) and light brownish gray (10YR 6/2) mottles; weak fine blocky structure; firm, very hard; few very fine pores; neutral.

The thickness of the solum and the depth to bedrock are more than 60 inches. The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 2. It is fine sandy loam or loam. It ranges from slightly acid to strongly acid. The Bt horizon has hue of 10YR and value of 3 to 5 (4 to 6 dry). It has chroma of 3 or 4 in the upper part and chroma of 3 to 6 in the lower part. It is sandy clay loam or clay loam. It ranges from slightly acid to strongly acid.

Sogn Series

The Sogn series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in limestone residuum. Slope ranges from 0 to 20 percent.

Sogn soils are commonly adjacent to Catoosa, Clime, and Labette soils. The calcareous Clime soils are 20 to 40 inches deep over shale. They are generally below the Sogn soils on the landscape. Catoosa and Labette soils are 20 to 40 inches deep over limestone. They are generally above the Sogn soils on the landscape.

Typical pedon of Sogn silty clay loam, in an area of Labette-Sogn silty clay loams, 0 to 8 percent slopes, near the center of sec. 23, T. 28 S., R. 9 E.

A—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; strong fine granular structure; firm, hard; many fine roots; about 10 percent limestone fragments less than 3 inches in size; mildly alkaline; abrupt wavy boundary.

R—8 inches; platy limestone that has a few crevices.

The thickness of the solum and the depth to limestone range from 4 to 20 inches. The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 (3 to 5 dry), and chroma of 1 to 3. It ranges from slightly acid to moderately alkaline. It is dominantly silty clay loam, but the range includes silt loam, stony silt loam, and stony silty clay loam.

Steedman Series

The Steedman series consists of moderately deep, moderately well drained, slowly permeable soils on uplands. These soils formed in shale residuum. Slope ranges from 5 to 20 percent.

Steedman soils are similar to Eram and Niotaze soils and are commonly adjacent to Eram, Niotaze, and Stephenville soils. Eram soils have a mollic epipedon. They are on ridgetops above the Steedman soils. Niotaze soils have an E horizon. They are below the Steedman soils on the landscape. Stephenville soils are underlain by sandstone and have a loamy subsoil. They are on ridgetops.

Typical pedon of Steedman stony loam, 5 to 20 percent slopes, 2,250 feet east and 400 feet south of northwest corner of sec. 7, T. 29 S., R. 13 E.

A—0 to 7 inches; very dark grayish brown (10YR 3/2) stony loam, grayish brown (10YR 5/2) dry; strong fine granular structure; very friable, slightly hard; many fine roots; about 20 percent sandstone fragments as much as 3 inches in size, a few as

much as 6 inches in size; strongly acid; clear wavy boundary.

Bt1—7 to 18 inches; dark brown (10YR 4/3) silty clay, brown (10YR 5/3) dry; common fine prominent yellowish red (5YR 4/6) mottles; strong fine subangular blocky structure; firm, hard; clay films on faces of peds; many fine roots; medium acid; gradual smooth boundary.

Bt2—18 to 27 inches; brown (10YR 5/3) silty clay, pale brown (10YR 6/3) dry; common medium distinct yellowish red (5YR 4/6) and dark reddish brown (2.5YR 3/4) mottles; moderate fine blocky structure; very firm, very hard; common fine roots; clay films on faces of peds; slightly acid; gradual smooth boundary.

BC—27 to 36 inches; grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/6) silty clay, light yellowish brown (2.5Y 6/4) and olive yellow (2.5Y 6/8) dry; weak medium blocky structure; few fine roots; very firm, extremely hard; few shale fragments less than 0.5 inch in size; neutral; gradual wavy boundary.

Cr—36 inches; clayey shale.

The thickness of the solum and the depth to shale range from 20 to 40 inches. Angular sandstone rocks more than 10 inches in size are on the surface in some areas.

The A horizon has hue of 10YR or 7.5YR, value of 3 or 4 (4 or 5 dry), and chroma of 1 to 3. It ranges from slightly acid to strongly acid. It is loam, silt loam, stony loam, or stony silt loam. The content of rock fragments smaller than 3 inches ranges from 0 to 25 percent in this horizon. The content of rock fragments larger than 3 inches ranges from 0 to 30 percent. The Bt horizon has hue of 5YR to 2.5Y and value of 4 or 5 (5 or 6 dry). It has chroma of 2 to 4 in the upper part and chroma of 2 to 6 in the lower part. It is silty clay or clay. It ranges from medium acid to moderately alkaline.

Stephenville Series

The Stephenville series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in sandstone residuum. Slope ranges from 1 to 6 percent.

Stephenville soils are similar to Bates soils and are commonly adjacent to Darnell, Niotaze, and Steedman soils. Bates soils have a mollic epipedon. Darnell soils are less than 20 inches deep over sandstone. They are in landscape positions similar to those of the Stephenville soils. Niotaze and Steedman soils have a clayey subsoil. They are generally on the steeper slopes.

Typical pedon of Stephenville fine sandy loam, in an area of Stephenville-Darnell fine sandy loams, 1 to 6 percent slopes, 1,300 feet east and 500 feet north of the southwest corner of sec. 33, T. 31 S., R. 13 E.

A—0 to 6 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; moderate fine granular structure; very friable, soft; many fine roots; slightly acid; clear wavy boundary.

E—6 to 11 inches; dark yellowish brown (10YR 4/4) fine sandy loam, light yellowish brown (10YR 6/4) dry; massive; very friable, soft; many fine roots; slightly acid; clear smooth boundary.

Bt—11 to 28 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 5/8) dry; moderate fine subangular blocky structure; firm, hard; common fine roots; strongly acid; gradual smooth boundary.

BC—28 to 32 inches; yellowish red (5YR 5/6) sandy clay loam, reddish yellow (5YR 6/8) dry; few medium and coarse distinct red (2.5YR 4/6) mottles; weak fine subangular blocky structure; firm, hard; common fine roots; few sandstone fragments less than 0.5 inch in diameter; strongly acid; abrupt wavy boundary.

Cr—32 inches; soft sandstone.

The thickness of the solum and the depth to sandstone range from 20 to 40 inches. The A horizon has hue of 5YR, 7.5YR, or 10YR, value of 3 to 5 (4 to 7 dry), and chroma of 2 to 4. It is fine sandy loam or loamy fine sand. It ranges from strongly acid to slightly acid. The Bt horizon has hue of 5YR or 2.5YR, value of 3 to 5 (4 to 6 dry), and chroma of 4 to 8. It is strongly acid or medium acid.

Verdigris Series

The Verdigris series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in silty alluvium. Slope ranges from 0 to 2 percent.

Verdigris soils are similar to Ivan, Lanton, and Mason soils and are commonly adjacent to Lanton and Mason soils. Ivan soils are calcareous. The somewhat poorly drained Lanton soils are mottled. They are farther from stream channels than the Verdigris soils. Mason soils have an argillic horizon. They are on rarely flooded terraces above the Verdigris soils.

Typical pedon of Verdigris silt loam, occasionally flooded, 2,400 feet east and 1,600 feet south of the northwest corner of sec. 28, T. 31 S., R. 13 E.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine granular structure; very friable, hard; common fine roots; neutral; clear smooth boundary.

A—7 to 27 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine granular structure; friable, hard; few worm casts and pores; few fine roots; neutral; gradual smooth boundary.

AC—27 to 54 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak fine subangular blocky

structure; friable, hard; many pores; neutral; diffuse smooth boundary.

C—54 to 60 inches; dark grayish brown (10YR 4/2) silt loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; friable, hard; many pores; neutral.

The solum ranges from 24 to 60 inches in thickness. It is medium acid to neutral. The depth to lime is more than 50 inches.

The A and AC horizons have hue of 7.5YR or 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 to 3. They are dominantly silt loam, but the range includes loam and silty clay loam. The C horizon has hue of 10YR or 7.5YR, value of 3 to 5 (4 to 7 dry), and chroma of 2 to 4. It is loam, silt loam, or silty clay loam. Some pedons have strata containing more clay or more sand below a depth of 40 inches. Some pedons have a dark Ab horizon below the C horizon.

Woodson Series

The Woodson series consists of deep, somewhat poorly drained, very slowly permeable soils on uplands. These soils formed in clayey sediments or shale residuum. Slope ranges from 0 to 2 percent.

Woodson soils are commonly adjacent to Eram, Kenoma, and Martin soils. The moderately well drained Eram soils are 20 to 40 inches deep over clayey shale. They are on side slopes below the Woodson soils. The moderately well drained Kenoma soils have a subsoil that is browner than that of the Woodson soils. They are on the more convex ridgetops. Martin soils have a BA horizon. They are on the lower side slopes.

Typical pedon of Woodson silt loam, 0 to 2 percent slopes, 900 feet south and 250 feet east of the northwest corner of sec. 27, T. 28 S., R. 13 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable, hard; light gray coatings in the lower 2 inches; many fine roots; slightly acid; abrupt smooth boundary.

Bt1—8 to 20 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; very firm, extremely hard; thin patchy clay films on faces of most peds; common fine roots; neutral; gradual smooth boundary.

Bt2—20 to 36 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; few fine distinct light olive brown (2.5Y 5/6) mottles; moderate fine blocky structure; extremely firm, extremely hard; few fine roots; thick continuous clay films on faces of most peds; neutral; gradual smooth boundary.

BC—36 to 46 inches; grayish brown (10YR 5/2) silty clay, light brownish gray (10YR 6/2) dry; common fine distinct yellowish brown (10YR 5/6) mottles; weak fine blocky structure; firm, very hard; thick continuous clay films on faces of most peds; neutral; gradual smooth boundary.

C—46 to 60 inches; light brownish gray (10YR 6/2) silty clay loam, light gray (10YR 7/2) dry; common medium distinct dark yellowish brown (10YR 4/4) and common fine prominent olive yellow (2.5Y 6/6) mottles; massive; firm, very hard; light gray coatings between some peds; few black streaks and stains; neutral.

The solum is 30 to 60 inches thick. The A horizon has hue of 10YR, value of 2 or 3 (3 to 5 dry), and chroma of 1. It is dominantly silt loam, but in some pedons it is silty clay loam. It is medium acid or slightly acid. The Bt horizon has hue of 10YR or 2.5Y, value of 2 to 4 (4 to 6 dry), and chroma of 1. It is silty clay or clay. It is medium acid to neutral.

Formation of the Soils

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of a soil at any given point are determined by the interaction of five factors of soil formation: 1) the physical and mineralogical composition of the parent material, 2) the climate under which the soil material has accumulated and has existed since accumulation, 3) the plant and animal life on and in the soil, 4) the relief, and 5) the length of time that the forces of soil formation have acted on the parent material. Each of these factors influences the formation of every soil, and each modifies the effects of the other four. The relative effects of the individual factors vary from place to place. The interactions among the factors are more complex for some soils than for others.

Parent Material

Parent material is the unconsolidated material in which soils form. It either is material weathered from rocks through freezing and thawing, abrasion, erosion, or chemical processes or is weathered material deposited by wind or water. The parent material affects texture, structure, color, natural fertility, and many other soil properties. Soils differ partly because of the various kinds of parent material. The texture of the parent material influences the rate of the downward movement of water and air and thus greatly affects soil formation. The composition of the parent material largely determines the mineralogical composition of the soil and, hence, its natural fertility.

Most of the soils in the western one-fourth of Elk County formed in material weathered from Lower Permian rocks. The eastern three-fourths of the county has soils that formed in material weathered from Upper Pennsylvanian rocks. A majority of the soils in the county formed in material weathered from limestone or shale. Other types of parent material include material weathered from sandstone, alluvial sediments, and some eolian and colluvial sediments.

Clime, Dennis, Eram, Martin, and Steedman soils formed in material weathered from shale. Catoosa, Labette, and Sogn soils formed in material weathered from limestone, and Florence soils formed in cherty limestone residuum. Bates, Collinsville, Darnell, and Stephenville soils formed in sandstone residuum.

Alluvium is water-deposited material. Two types of alluvial sediments are evident in Elk County—recent alluvium and old alluvium. The recent alluvium is in the stream valleys. Ivan, Lanton, Mason, Osage, and Verdigris soils formed in this material. Old alluvial sediments are on what are now uplands. Some of the Kenoma and Woodson soils formed in these sediments.

Some soils formed in material derived from more than one source. The lower part of the Niotaze soils, for example, formed in material weathered from shale. In many areas, however, the upper part of these soils appears to be of sandstone origin. The upper part of Kenoma, Newtonia, and Woodson soils may have been somewhat influenced by eolian, or windblown, sediments. In some areas Dennis and Martin soils formed in colluvium.

Climate

Climate is an active factor of soil formation. It directly influences soil formation by weathering the parent material. It indirectly affects soil formation through its effect on plants and animals.

The climate of Elk County is typical continental. It is characterized by intermittent dry and moist periods, which can last for less than a year or for several years. The soil material dries to varying depths during dry periods. It slowly regains moisture during wet periods and can become so saturated that excess moisture penetrates the substratum. Because of the wetting and drying, some of the basic nutrients, and even clay particles, have been leached from the upper horizons in most of the soils.

Plant and Animal Life

Plants and animals have important effects on soil formation. Plants generally influence the amount of nutrients and organic matter in the soil and the color of the surface layer. Earthworms, cicadas, and burrowing animals help to keep the soil open and porous. Bacteria and fungi help to decompose the plants, thus releasing plant nutrients.

The mid and tall prairie grasses have had the greatest influence on soil formation in Elk County. As a result of the grasses, the upper part of a typical soil in the county is dark and is high in content of organic matter. The transitional part in many areas is slightly finer textured and somewhat lighter colored than the layer above. The

underlying parent material generally is light in color. The soils that formed under a canopy of oaks in the eastern part of the county do not have a thick, dark surface layer and are more acid than the soils that formed under prairie grasses.

Relief

Relief, or lay of the land, influences the formation of soils through its effect on drainage, runoff, plant cover, and soil temperature. Although climate and plants are the most active factors of soil formation, relief also is important, mainly because it controls the movement of water on the surface and into the soil.

Runoff is more rapid on the steeper upland soils than on the less sloping soils. As a result, erosion is more extensive. Clime soils formed in old parent material, but relief has restricted their formation. Runoff is rapid on these moderately sloping to moderately steep soils, and much of the soil material is removed as soon as a soil forms.

Time

The length of time that the soil material has been subject to weathering and the soil-forming processes is commonly reflected in the degree of profile development. Soils that do not have distinct horizons are considered young, whereas those that have distinct horizons are considered old, or mature.

The soils in Elk County range from immature to mature. Young soils, such as Ivan and Verdigris soils, are on bottom land that is subject to stream overflow. They receive new sediment with each flood. They have been in place long enough to develop a thick, dark surface layer, but little or no clay has moved downward through the profile. In contrast, the mature Kenoma and Woodson soils have very distinct horizons. Much of the clay has been translocated to the subsoil. Thousands of years were needed for such stages of horizon development.

References

(1) American Association of State Highway and Transportation Officials. 1982. Standard specifications for highway materials and methods of sampling and testing. Ed. 13, 2 vols., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Kansas State Board of Agriculture. 1981. 1980-1981 farm facts. Spec. Rep. Kans. Crop and Kans. Cattle Mark. Stat., 276 pp., illus.

(4) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus.

(5) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(6) United States Department of Agriculture, Soil Conservation Service. 1969. Kansas conservation needs inventory. 191 pp.

Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a

catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Natric horizon. A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8

Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent

material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Data were recorded in the period 1951-76 at Howard, Kansas]

Month	Temperature					Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	In	In	In		In
January----	44.0	20.0	32.0	72	-8	1.01	0.24	1.62	2	3.7
February---	50.1	25.0	37.6	79	1	1.07	.26	1.74	3	3.1
March------	58.3	32.3	45.3	86	7	2.40	.91	3.19	5	2.9
April------	70.8	44.9	57.9	91	20	3.27	1.93	4.02	5	.1
May--------	78.6	54.1	66.4	94	32	4.83	2.21	7.51	7	.0
June-------	86.4	62.9	74.7	101	46	4.63	2.53	6.67	7	.0
July-------	92.2	66.9	79.6	105	50	3.99	.78	6.24	6	.0
August-----	92.1	65.2	78.7	105	49	3.58	1.16	5.51	5	.0
September--	83.2	57.1	70.2	101	36	4.71	1.33	7.84	6	.0
October----	73.4	46.0	59.7	93	24	3.23	.80	4.29	4	.0
November---	58.3	33.3	45.8	80	7	2.01	.13	4.11	3	1.2
December---	46.9	24.5	35.7	72	-3	1.32	.74	1.84	3	2.7
Year------	69.5	44.4	57.0	108	-9	36.05	24.52	43.94	56	13.7

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Minimum temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 6	April 16	April 28
2 years in 10 later than--	April 1	April 11	April 23
5 years in 10 later than--	March 23	April 1	April 13
First freezing temperature in fall:			
1 year in 10 earlier than--	October 28	October 20	October 11
2 years in 10 earlier than--	November 1	October 25	October 15
5 years in 10 earlier than--	November 11	November 3	October 25

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	210	195	174
8 years in 10	218	202	181
5 years in 10	233	216	195
2 years in 10	249	230	209
1 year in 10	257	237	217

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ba	Bates fine sandy loam, 1 to 4 percent slopes	2,150	0.5
Bb	Bates loam, 4 to 7 percent slopes	4,050	1.0
Bf	Benfield cherty silt loam, 4 to 10 percent slopes	1,850	0.4
Cd	Catoosa silt loam, 0 to 2 percent slopes	10,500	2.5
Cf	Catoosa-Sogn complex, 0 to 8 percent slopes	25,750	6.2
Ck	Clime stony silty clay loam, 20 to 30 percent slopes	9,400	2.3
Cm	Clime silty clay, 3 to 7 percent slopes	970	0.2
Cs	Clime-Sogn complex, 5 to 20 percent slopes	63,800	15.4
Cv	Collinsville-Bates fine sandy loams, 2 to 8 percent slopes	2,600	0.6
De	Dennis silt loam, 1 to 4 percent slopes	21,250	5.1
Df	Dennis silt loam, 4 to 7 percent slopes	3,350	0.8
Dg	Dennis silty clay loam, 3 to 7 percent slopes, eroded	550	0.1
Dw	Dwight silt loam, 0 to 2 percent slopes	1,150	0.3
Em	Eram silt loam, 1 to 4 percent slopes	23,100	5.5
En	Eram silty clay loam, 4 to 7 percent slopes	21,900	5.3
Eo	Eram silty clay loam, 3 to 7 percent slopes, eroded	3,850	0.9
Es	Eram-Dwight silt loams, 1 to 4 percent slopes	1,800	0.4
Fe	Fiat silty clay loam, 1 to 3 percent slopes	6,000	1.4
Fm	Florence-Martin complex, 2 to 12 percent slopes	9,500	2.3
Iv	Ivan silt loam, channeled	2,250	0.5
Iw	Ivan silt loam, occasionally flooded	4,850	1.2
Kd	Kenoma silt loam, 1 to 3 percent slopes	17,800	4.3
La	Labette silty clay loam, 1 to 4 percent slopes	1,050	0.3
Ld	Labette-Dwight complex, 0 to 3 percent slopes	11,200	2.7
Lg	Labette-Sogn silty clay loams, 0 to 8 percent slopes	13,900	3.3
Ln	Lanton silty clay loam, occasionally flooded	5,100	1.2
Mb	Martin silty clay loam, 1 to 4 percent slopes	16,200	3.9
Mc	Martin silty clay loam, 4 to 7 percent slopes	5,550	1.3
Me	Martin silty clay, 3 to 7 percent slopes, eroded	1,050	0.3
Mn	Mason silt loam	12,100	2.9
Nc	Newtonia silt loam, 1 to 3 percent slopes	900	0.2
Nd	Niotaze-Darnell complex, 6 to 35 percent slopes	10,850	2.6
Os	Osage silty clay loam, occasionally flooded	460	0.1
Po	Pits, quarries	750	0.2
Pr	Prue fine sandy loam, 2 to 6 percent slopes	1,850	0.4
Sh	Sogn silty clay loam, 0 to 3 percent slopes	4,850	1.2
St	Steedman stony loam, 5 to 20 percent slopes	57,500	13.9
Sv	Stephenville fine sandy loam, 1 to 4 percent slopes	253	0.1
Sw	Stephenville-Darnell fine sandy loams, 1 to 6 percent slopes	13,000	3.1
Vd	Verdigris silt loam, channeled	2,600	0.6
Vf	Verdigris silt loam, occasionally flooded	9,400	2.3
Wo	Woodson silt loam, 0 to 2 percent slopes	8,100	1.9
	Water	1,250	0.3
	Total	416,333	100.0

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Land capability	Winter wheat	Grain sorghum	Soybeans	Alfalfa hay	Tall fescue
		Bu	Bu	Bu	Tons	AUM*
Ba: Bates	IIe	36	55	25	3.0	5.5
Bb: Bates	IIIe	32	50	20	2.5	5.5
Bf: Benfield	VIe	---	---	---	---	---
Cd: Catoosa	IIe	40	65	25	3.5	5.5
Cf: Catoosa-Sogn	VIe	---	---	---	---	---
Ck: Clime	VIIe	---	---	---	---	---
Cm: Clime	IVe	30	46	18	1.6	4.5
Cs: Clime-Sogn	VIe	---	---	---	---	---
Cv: Collinsville-Bates	VIe	---	---	---	---	---
De: Dennis	IIe	40	72	30	4.5	6.0
Df: Dennis	IIIe	38	70	26	3.5	6.0
Dg: Dennis	IVe	33	60	20	3.5	5.0
Dw: Dwight	IVs	24	36	---	---	3.5
Em: Eram	IIIe	33	55	22	3.0	5.5
En: Eram	IVe	30	45	17	2.5	4.5
Eo: Eram	IVe	20	35	14	2.0	4.0
Es: Eram-Dwight	IVe	22	37	15	2.6	4.0
Fe: Fiat	IIIe	30	45	20	2.5	4.6
Fm: Florence-Martin	VIe	---	---	---	---	---
Iv: Ivan	Vw	---	---	---	---	---

See footnotes at end of table.

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Winter wheat	Grain sorghum	Soybeans	Alfalfa hay	Tall fescue
		Bu	Bu	Bu	Tons	AUM*
Iw: Ivan	IIw	48	95	34	5.5	8.0
Kd: Kenoma	IIIe	37	70	26	3.2	5.0
La: Labette	IIe	37	60	23	3.0	5.0
Ld: Labette-Dwight	IIIe	31	50	20	2.5	4.3
Lg: Labette-Sogn	VIe	---	---	---	---	---
Ln: Lanton	IIw	45	92	32	5.0	8.0
Mb: Martin	IIe	40	72	30	3.5	6.0
Mc: Martin	IIIe	35	67	26	3.2	5.5
Me: Martin	IVe	31	60	20	2.6	5.0
Mn: Mason	I	48	92	35	5.5	7.5
Nc: Newtonia	IIe	45	75	32	4.5	7.0
Nd: Niotaze-Darnell	VIe	---	---	---	---	---
Os: Osage	IIw	35	75	30	4.0	7.5
Po**. Pits						
Pr: Prue	IIIe	37	65	20	3.5	6.0
Sh: Sogn	VIIs	---	---	---	---	---
St: Steedman	VIe	---	---	---	---	---
Sv: Stephenville	IIe	36	52	26	3.0	5.5
Sw: Stephenville-Darnell	VIe	---	---	---	---	---
Vd: Verdigris	Vw	---	---	---	---	---
Vf: Verdigris	IIw	48	95	34	5.5	8.0

See footnotes at end of table.

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Winter wheat	Grain sorghum	Soybeans	Alfalfa hay	Tall fescue
		Bu	Bu	Bu	Tons	AUM*
Wo------------------------ Woodson	IIs	35	70	27	3.3	5.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Ba, Bb------------ Bates	Loamy Upland----------------	Favorable	6,000	Big bluestem----------------	35
		Normal	4,500	Little bluestem-------------	25
		Unfavorable	3,000	Indiangrass-----------------	15
				Switchgrass-----------------	10
Bf---------------- Benfield	Loamy Upland----------------	Favorable	5,000	Big bluestem----------------	25
		Normal	4,000	Little bluestem-------------	20
		Unfavorable	3,000	Indiangrass-----------------	10
				Switchgrass-----------------	10
				Sideoats grama--------------	5
Cd---------------- Catoosa	Loamy Upland----------------	Favorable	6,000	Little bluestem-------------	25
		Normal	4,500	Big bluestem----------------	20
		Unfavorable	3,500	Indiangrass-----------------	10
				Switchgrass-----------------	10
				Sideoats grama--------------	5
Cf*:					
Catoosa-----------	Loamy Upland----------------	Favorable	6,000	Little bluestem-------------	25
		Normal	4,500	Big bluestem----------------	25
		Unfavorable	3,000	Indiangrass-----------------	10
				Switchgrass-----------------	10
				Sideoats grama--------------	5
Sogn--------------	Shallow Limy----------------	Favorable	3,500	Sideoats grama--------------	25
		Normal	2,500	Big bluestem----------------	15
		Unfavorable	1,500	Little bluestem-------------	15
				Indiangrass-----------------	5
				Switchgrass-----------------	5
				Tall dropseed---------------	5
				Blue grama------------------	5
Ck, Cm------------ Clime	Limy Upland-----------------	Favorable	5,000	Little bluestem-------------	30
		Normal	3,500	Big bluestem----------------	20
		Unfavorable	2,500	Sideoats grama--------------	15
				Indiangrass-----------------	5
				Switchgrass-----------------	5
Cs*:					
Clime-------------	Limy Upland-----------------	Favorable	5,000	Little bluestem-------------	30
		Normal	3,500	Big bluestem----------------	20
		Unfavorable	2,500	Sideoats grama--------------	15
				Indiangrass-----------------	5
				Switchgrass-----------------	5
Sogn--------------	Shallow Limy----------------	Favorable	3,500	Sideoats grama--------------	25
		Normal	2,500	Big bluestem----------------	15
		Unfavorable	1,500	Little bluestem-------------	15
				Indiangrass-----------------	5
				Switchgrass-----------------	5
				Tall dropseed---------------	5
				Blue grama------------------	5
Cv*:					
Collinsville------	Shallow Sandstone-----------	Favorable	4,000	Little bluestem-------------	30
		Normal	3,000	Big bluestem----------------	20
		Unfavorable	2,000	Indiangrass-----------------	10
				Switchgrass-----------------	10
				Sideoats grama--------------	10

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Cv*:					
Bates	Loamy Upland	Favorable	6,000	Big bluestem	35
		Normal	4,500	Little bluestem	25
		Unfavorable	3,500	Indiangrass	15
				Switchgrass	10
De, Df, Dg Dennis	Loamy Upland	Favorable	6,500	Big bluestem	35
		Normal	5,000	Switchgrass	15
		Unfavorable	3,000	Little bluestem	15
				Indiangrass	15
Dw Dwight	Claypan	Favorable	4,000	Big bluestem	15
		Normal	3,000	Little bluestem	10
		Unfavorable	2,000	Tall dropseed	10
				Blue grama	10
				Western wheatgrass	10
				Switchgrass	10
				Sideoats grama	10
				Buffalograss	5
Em Eram	Loamy Upland	Favorable	6,500	Big bluestem	35
		Normal	5,000	Little bluestem	25
		Unfavorable	3,500	Indiangrass	15
				Switchgrass	10
En, Eo Eram	Clay Upland	Favorable	6,000	Big bluestem	30
		Normal	4,200	Little bluestem	20
		Unfavorable	2,500	Switchgrass	10
				Indiangrass	10
				Tall dropseed	5
Es*:					
Eram	Loamy Upland	Favorable	6,500	Big bluestem	30
		Normal	5,000	Little bluestem	15
		Unfavorable	3,500	Switchgrass	15
				Indiangrass	10
Dwight	Claypan	Favorable	4,000	Big bluestem	15
		Normal	3,000	Little bluestem	10
		Unfavorable	2,000	Tall dropseed	10
				Blue grama	10
Fe Fiat	Clay Upland	Favorable	5,000	Big bluestem	35
		Normal	4,300	Switchgrass	15
		Unfavorable	2,500	Little bluestem	10
				Indiangrass	10
				Tall dropseed	5
Fm*:					
Florence	Loamy Upland	Favorable	5,500	Big bluestem	30
		Normal	4,500	Little bluestem	20
		Unfavorable	3,500	Indiangrass	10
				Switchgrass	10
				Eastern gamagrass	5
				Tall dropseed	5
				Sideoats grama	5
Martin	Loamy Upland	Favorable	6,500	Big bluestem	30
		Normal	5,000	Little bluestem	15
		Unfavorable	3,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Sideoats grama	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Iv, Iw: Ivan	Loamy Lowland	Favorable	10,000	Big bluestem	40
		Normal	8,000	Indiangrass	20
		Unfavorable	6,000	Switchgrass	10
				Eastern gamagrass	10
				Prairie cordgrass	5
				Little bluestem	5
Kd: Kenoma	Clay Upland	Favorable	6,000	Big bluestem	25
		Normal	4,500	Little bluestem	20
		Unfavorable	2,500	Indiangrass	15
				Switchgrass	15
				Tall dropseed	5
				Sideoats grama	5
La: Labette	Loamy Upland	Favorable	5,500	Big bluestem	30
		Normal	4,500	Little bluestem	20
		Unfavorable	3,000	Indiangrass	15
				Switchgrass	10
				Eastern gamagrass	5
Ld*:					
Labette	Loamy Upland	Favorable	5,500	Big bluestem	30
		Normal	4,500	Little bluestem	20
		Unfavorable	3,000	Indiangrass	15
				Switchgrass	10
				Eastern gamagrass	5
Dwight	Claypan	Favorable	4,000	Big bluestem	15
		Normal	3,000	Little bluestem	10
		Unfavorable	2,000	Prairie dropseed	10
				Tall dropseed	10
				Blue grama	10
				Western wheatgrass	10
				Switchgrass	5
				Sideoats grama	5
				Buffalograss	5
Lg*:					
Labette	Loamy Upland	Favorable	5,500	Big bluestem	30
		Normal	4,500	Little bluestem	20
		Unfavorable	3,000	Indiangrass	15
				Switchgrass	10
				Eastern gamagrass	5
Sogn	Shallow Limy	Favorable	3,500	Sideoats grama	25
		Normal	2,500	Big bluestem	15
		Unfavorable	1,500	Little bluestem	15
				Indiangrass	5
				Switchgrass	5
				Tall dropseed	5
				Blue grama	5
Ln: Lanton	Loamy Lowland	Favorable	10,000	Big bluestem	30
		Normal	8,800	Prairie cordgrass	15
		Unfavorable	6,000	Indiangrass	15
				Switchgrass	10
				Eastern gamagrass	10

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo-sition
			Lb/acre		Pct
Mb, Mc: Martin	Loamy Upland	Favorable	6,500	Big bluestem	30
		Normal	5,500	Little bluestem	15
		Unfavorable	3,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Sideoats grama	5
Me: Martin	Loamy Upland	Favorable	5,000	Big bluestem	30
		Normal	3,500	Little bluestem	15
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Sideoats grama	5
Mn: Mason	Loamy Lowland	Favorable	10,000	Big bluestem	35
		Normal	8,000	Indiangrass	15
		Unfavorable	6,000	Switchgrass	10
				Little bluestem	10
				Eastern gamagrass	5
				Beaked panicum	5
Nc: Newtonia	Loamy Upland	Favorable	6,500	Big bluestem	35
		Normal	5,500	Indiangrass	15
		Unfavorable	3,500	Little bluestem	15
				Switchgrass	10
Nd*:					
Niotaze	Savannah	Favorable	5,000	Little bluestem	25
		Normal	3,800	Big bluestem	20
		Unfavorable	3,000	Post oak	10
				Blackjack oak	10
				Indiangrass	5
				Switchgrass	5
				Purpletop	5
Darnell	Shallow Savannah	Favorable	3,200	Little bluestem	30
		Normal	2,100	Big bluestem	20
		Unfavorable	1,400	Post oak	15
				Blackjack oak	10
				Indiangrass	5
				Switchgrass	5
Os: Osage	Loamy Lowland	Favorable	9,000	Big bluestem	25
		Normal	7,000	Prairie cordgrass	15
		Unfavorable	6,000	Switchgrass	10
				Indiangrass	10
				Eastern gamagrass	10
				Little bluestem	5
Pr: Prue	Loamy Upland	Favorable	6,500	Big bluestem	35
		Normal	5,200	Switchgrass	15
		Unfavorable	3,500	Little bluestem	10
				Indiangrass	10
				Scribner panicum	5
				Tall dropseed	5
Sh: Sogn	Shallow Limy	Favorable	3,500	Sideoats grama	25
		Normal	2,500	Big bluestem	15
		Unfavorable	1,500	Little bluestem	15
				Indiangrass	5
				Switchgrass	5
				Tall dropseed	5
				Blue grama	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
St------------------ Steedman	Loamy Upland------------------	Favorable	5,500	Big bluestem------------------	35
		Normal	4,000	Little bluestem---------------	20
		Unfavorable	3,000	Indiangrass-------------------	10
				Switchgrass-------------------	10
				Sideoats grama----------------	5
Sv------------------ Stephenville	Savannah----------------------	Favorable	5,500	Big bluestem------------------	25
		Normal	4,300	Little bluestem---------------	15
		Unfavorable	3,000	Indiangrass-------------------	10
				Switchgrass-------------------	10
				Blackjack oak-----------------	5
Sw*:					
Stephenville------	Savannah----------------------	Favorable	5,500	Big bluestem------------------	25
		Normal	4,300	Little bluestem---------------	15
		Unfavorable	3,500	Indiangrass-------------------	10
				Switchgrass-------------------	10
				Blackjack oak-----------------	5
Darnell-----------	Shallow Savannah--------------	Favorable	3,200	Little bluestem---------------	30
		Normal	2,100	Big bluestem------------------	20
		Unfavorable	1,400	Post oak----------------------	15
				Blackjack oak-----------------	10
				Indiangrass-------------------	5
				Switchgrass-------------------	5
Vd, Vf------------- Verdigris	Loamy Lowland-----------------	Favorable	10,000	Big bluestem------------------	30
		Normal	8,500	Indiangrass-------------------	15
		Unfavorable	6,000	Eastern gamagrass-------------	15
				Switchgrass-------------------	10
				Prairie cordgrass-------------	5
Wo------------------ Woodson	Clay Upland-------------------	Favorable	6,000	Big bluestem------------------	35
		Normal	4,500	Little bluestem---------------	15
		Unfavorable	2,500	Indiangrass-------------------	15
				Switchgrass-------------------	15
				Tall dropseed-----------------	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Plant competition	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
Iv, Iw Ivan	4a	Slight	Slight	Slight	Moderate	Black walnut Hackberry Bur oak Green ash Silver maple	73 74 50 90 89	Black walnut, pecan, eastern cottonwood, green ash, hackberry, bur oak.
Ln Lanton	4w	Slight	Severe	Slight	Severe	Eastern cottonwood Green ash	80 71	Pecan, eastern cottonwood.
Mn Mason	4a	Slight	Slight	Slight	Moderate	Northern red oak Green ash Black walnut Eastern cottonwood	65 75 75 90	Bur oak, green ash, black walnut, pecan, American sycamore.
Nd*:								
Niotaze	5r	Moderate	Moderate	Slight	Slight	Post oak Blackjack oak Southern red oak	30 25 35	Post oak, blackjack oak, bur oak.
Darnell	5r	Moderate	Moderate	Moderate	Slight	Post oak Blackjack oak	30 30	Northern red oak, bur oak.
Os Osage	4w	Slight	Moderate	Moderate	Severe	Pin oak Pecan Eastern cottonwood Bur oak	75 50 80 ---	Pin oak, pecan.
Sv Stephenville	5a	Slight	Slight	Slight	Slight	Post oak Blackjack oak	35 35	Bur oak.
Sw*:								
Stephenville	5a	Slight	Slight	Slight	Slight	Post oak Blackjack oak	35 25	Bur oak.
Darnell	5r	Moderate	Moderate	Moderate	Slight	Post oak Blackjack oak	30 30	Northern red oak, bur oak.
Vd, Vf Verdigris	3a	Slight	Slight	Slight	Moderate	Eastern cottonwood Pin oak Shagbark hickory Hackberry Black walnut Silver maple Green ash White oak	87 75 --- 69 69 --- 69 56	Eastern cottonwood, American sycamore, pin oak, black walnut, green ash.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ba, Bb: Bates	Lilac, Peking cotoneaster, Amur honeysuckle, fragrant sumac.	---	Eastern redcedar, green ash, Austrian pine, bur oak, hackberry, Russian-olive.	Siberian elm, honeylocust.	---
Bf: Benfield	Siberian peashrub, Peking cotoneaster, lilac.	Amur honeysuckle, Manchurian crabapple.	Eastern redcedar, Austrian pine, Russian-olive, hackberry, green ash.	Siberian elm, honeylocust.	---
Cd: Catoosa	Amur honeysuckle, fragrant sumac, Peking cotoneaster, lilac.	---	Bur oak, Russian-olive, hackberry, eastern redcedar, green ash, Austrian pine.	Honeylocust, Siberian elm.	---
Cf*:					
Catoosa	Amur honeysuckle, fragrant sumac, Peking cotoneaster, lilac.	---	Bur oak, Russian-olive, hackberry, eastern redcedar, green ash, Austrian pine.	Honeylocust, Siberian elm.	---
Sogn.					
Ck, Cm: Clime	Fragrant sumac, Tatarian honeysuckle.	Siberian peashrub	Eastern redcedar, green ash, osageorange, Russian-olive, black locust, honeylocust, northern catalpa, bur oak.	Siberian elm	---
Cs*:					
Clime	Fragrant sumac, Tatarian honeysuckle.	Siberian peashrub	Eastern redcedar, green ash, osageorange, Russian-olive, black locust, honeylocust, northern catalpa, bur oak.	Siberian elm	---
Sogn.					
Cv*:					
Collinsville.					
Bates	Lilac, Peking cotoneaster, Amur honeysuckle, fragrant sumac.	---	Eastern redcedar, green ash, Austrian pine, bur oak, hackberry, Russian-olive.	Siberian elm, honeylocust.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
De, Df, Dg: Dennis	American plum, fragrant sumac, Peking cotoneaster, lilac.	---	Flowering dogwood, Russian mulberry, hackberry, eastern redcedar, green ash.	Honeylocust, Austrian pine, Scotch pine.	---
Dw: Dwight	Lilac, silver buffaloberry, Tatarian honeysuckle, Siberian peashrub.	Eastern redcedar, Russian-olive, Siberian elm, green ash.	---	---	---
Em, En, Eo: Eram	Lilac, Peking cotoneaster.	Manchurian crabapple, Amur honeysuckle, Siberian peashrub.	Eastern redcedar, hackberry, green ash, Austrian pine, Russian-olive.	Siberian elm, honeylocust.	---
Es*:					
Eram	Lilac, Peking cotoneaster.	Manchurian crabapple, Amur honeysuckle, Siberian peashrub.	Eastern redcedar, hackberry, green ash, Austrian pine, Russian-olive.	Siberian elm, honeylocust.	---
Dwight	Lilac, silver buffaloberry, Tatarian honeysuckle, Siberian peashrub.	Eastern redcedar, Russian-olive, Siberian elm, green ash.	---	---	---
Fe: Fiat	Amur honeysuckle, lilac.	Eastern redcedar, Manchurian crabapple, Amur maple.	Austrian pine, honeylocust, hackberry, green ash, Russian-olive.	---	---
Fm*:					
Florence	Lilac, Peking cotoneaster, Amur honeysuckle, fragrant sumac.	---	Eastern redcedar, hackberry, bur oak, Austrian pine, green ash, Russian-olive.	Honeylocust, Siberian elm.	---
Martin	Peking cotoneaster, lilac.	Amur honeysuckle, Siberian peashrub, Manchurian crabapple.	Green ash, hackberry, Austrian pine, eastern redcedar, Russian-olive.	Honeylocust, Siberian elm.	---
Iv, Iw: Ivan	---	American plum, lilac, Peking cotoneaster, Amur honeysuckle.	Eastern redcedar	Honeylocust, Austrian pine, green ash, hackberry, bur oak.	Eastern cottonwood.
Kd: Kenoma	Peking cotoneaster, lilac, fragrant sumac.	Amur honeysuckle, Manchurian crabapple.	Green ash, hackberry, Austrian pine, Russian-olive, eastern redcedar.	Siberian elm, honeylocust.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
La: Labette	Peking cotoneaster, lilac.	Amur honeysuckle, Siberian pea-shrub, Manchurian crabapple.	Russian-olive, eastern redcedar, green ash, Austrian pine, hackberry.	Siberian elm, honeylocust.	---
Ld*: Labette	Peking cotoneaster, lilac.	Amur honeysuckle, Siberian pea-shrub, Manchurian crabapple.	Russian-olive, eastern redcedar, green ash, Austrian pine, hackberry.	Siberian elm, honeylocust.	---
Dwight	Lilac, silver buffaloberry, Tatarian honeysuckle, Siberian peashrub.	Eastern redcedar, Russian-olive, Siberian elm, green ash.	---	---	---
Lg*: Labette	Peking cotoneaster, lilac.	Amur honeysuckle, Siberian pea-shrub, Manchurian crabapple.	Russian-olive, eastern redcedar, green ash, Austrian pine, hackberry.	Siberian elm, honeylocust.	---
Sogn.					
Ln: Lanton	---	Amur honeysuckle, lilac, Amur maple, autumn-olive.	Eastern redcedar, hackberry.	Austrian pine, pin oak, green ash, hackberry, honeylocust, eastern white pine.	Eastern cottonwood.
Mb, Mc, Me: Martin	Peking cotoneaster, lilac.	Amur honeysuckle, Siberian pea-shrub, Manchurian crabapple.	Green ash, hackberry, Austrian pine, eastern redcedar, Russian-olive.	Honeylocust, Siberian elm.	---
Mn: Mason	---	American plum, Peking cotoneaster, lilac, Amur honeysuckle.	Eastern redcedar, hackberry.	Austrian pine, honeylocust, green ash, bur oak, eastern white pine.	Eastern cottonwood.
Nc: Newtonia	Peking cotoneaster, lilac, fragrant sumac, Amur honeysuckle.	---	Eastern redcedar, hackberry, green ash, bur oak.	Austrian pine, Scotch pine, honeylocust.	---
Nd*: Niotaze	Lilac, fragrant sumac, Peking cotoneaster, Amur honeysuckle.	---	Austrian pine, hackberry, green ash, bur oak, Russian-olive, eastern redcedar.	Honeylocust, Siberian elm.	---
Darnell.					

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Os---------------- Osage	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Norway spruce, honeylocust, green ash, silver maple, golden willow, northern red oak.	Eastern cottonwood.
Po*. Pits					
Pr---------------- Prue	---	Lilac, Amur honeysuckle, fragrant sumac.	Hackberry, eastern redcedar, green ash, bur oak, Russian-olive.	Austrian pine, Scotch pine, honeylocust.	---
Sh. Sogn					
St---------------- Steedman	Amur honeysuckle, lilac, Peking cotoneaster.	---	Eastern redcedar, Austrian pine, green ash.	Siberian elm, honeylocust.	---
Sv---------------- Stephenville	Amur honeysuckle, lilac, fragrant sumac, Peking cotoneaster.	---	Eastern redcedar, hackberry, Austrian pine, bur oak, Russian-olive.	Honeylocust, Siberian elm.	---
Sw*:					
Stephenville-----	Amur honeysuckle, lilac, fragrant sumac, Peking cotoneaster.	---	Eastern redcedar, hackberry, Austrian pine, bur oak, Russian-olive.	Honeylocust, Siberian elm.	---
Darnell.					
Vd, Vf------------ Verdigris	---	American plum, lilac, Peking cotoneaster, Amur honeysuckle.	Eastern redcedar	Austrian pine, honeylocust, eastern white pine, bur oak, green ash, hackberry.	Eastern cottonwood.
Wo---------------- Woodson	Peking cotoneaster, lilac, fragrant sumac.	Manchurian crabapple, Amur honeysuckle.	Green ash, hackberry, eastern redcedar, Russian-olive.	Austrian pine, honeylocust, Siberian elm.	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ba, Bb: Bates	Slight	Slight	Moderate: slope, small stones, depth to rock.	Slight.
Bf: Benfield	Moderate: small stones.	Moderate: small stones.	Severe: slope, small stones.	Slight.
Cd: Catoosa	Slight	Slight	Slight	Slight.
Cf*:				
Catoosa	Slight	Slight	Moderate: slope, depth to rock.	Slight.
Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
Ck: Clime	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Cm: Clime	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope.	Slight.
Cs*:				
Clime	Moderate: slope, too clayey.	Moderate: slope, too clayey.	Severe: slope.	Slight.
Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
Cv*:				
Collinsville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
Bates	Slight	Slight	Moderate: slope, small stones, depth to rock.	Slight.
De, Df, Dg: Dennis	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.
Dw: Dwight	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Em, En, Eo: Eram	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight.
Es*:				
Eram	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Es*:				
Dwight	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Fe Fiat	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.
Fm*:				
Florence	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe: small stones.
Martin	Moderate: wetness.	Moderate: wetness.	Severe: slope.	Slight.
Iv Ivan	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Iw Ivan	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Kd Kenoma	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight.
La Labette	Slight	Slight	Moderate: slope, small stones, depth to rock.	Slight.
Ld*:				
Labette	Slight	Slight	Moderate: small stones.	Slight.
Dwight	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Lg*:				
Labette	Slight	Slight	Moderate: slope, small stones, depth to rock.	Slight.
Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
Ln Lanton	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.
Mb, Mc Martin	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight.
Me Martin	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
Mn Mason	Severe: flooding.	Moderate: percs slowly.	Moderate: percs slowly.	Slight.
Nc Newtonia	Slight	Slight	Moderate: slope.	Slight.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Nd*:				
Niotaze	Severe: wetness, slope.	Severe: slope.	Severe: large stones, slope, small stones.	Moderate: wetness, slope, large stones.
Darnell	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
Os: Osage	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
Po*. Pits				
Pr: Prue	Slight	Slight	Moderate: slope.	Slight.
Sh: Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
St: Steedman	Severe: large stones, wetness.	Severe: large stones, wetness.	Severe: wetness, large stones, slope.	Severe: wetness, large stones.
Sv: Stephenville	Slight	Slight	Moderate: slope, depth to rock.	Slight.
Sw*:				
Stephenville	Slight	Slight	Moderate: slope, depth to rock.	Slight.
Darnell	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
Vd: Verdigris	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Vf: Verdigris	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Wo: Woodson	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Ba, Bb-------------- Bates	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
Bf------------------ Benfield	Fair	Good	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Cd------------------ Catoosa	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
Cf*:												
Catoosa-----------	Fair	Good	Good	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.	Good.
Sogn--------------	Very poor.	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
Ck------------------ Clime	Poor	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Cm------------------ Clime	Fair	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Cs*:												
Clime-------------	Poor	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Sogn--------------	Very poor.	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
Cv*:												
Collinsville------	Very poor.	Poor	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Poor.
Bates-------------	Fair	Good	Good	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.	Good.
De------------------ Dennis	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
Df, Dg-------------- Dennis	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
Dw------------------ Dwight	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Fair	Fair	Poor	Poor	Fair.
Em------------------ Eram	Fair	Good	Good	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor	Fair.
En, Eo-------------- Eram	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Es*:												
Eram--------------	Fair	Good	Good	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor	Fair.
Dwight------------	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Fair	Fair	Poor	Poor	Fair.
Fe------------------ Fiat	Fair	Good	Good	Good	Good	Good	Poor	Poor	Good	Fair	Poor	Good.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Fm*:												
Florence	Poor	Good	Fair	Poor	Poor	Fair	Poor	Very poor.	Fair	Poor	Very poor.	Fair.
Martin	Poor	Good	Good	Fair	Fair	Good	Poor	Very poor.	Fair	Fair	Very poor.	Fair.
Iv: Ivan	Poor	Good	Good	Good	Good	Good	Poor	Fair	Fair	Good	Fair	Good.
Iw: Ivan	Good	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Fair	Good.
Kd: Kenoma	Good	Good	Fair	Fair	Fair	Fair	Poor	Fair	Good	Fair	Poor	Fair.
La: Labette	Fair	Good	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor	Fair.
Ld*:												
Labette	Fair	Good	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor	Fair.
Dwight	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Fair	Fair	Poor	Poor	Fair.
Lg*:												
Labette	Poor	Good	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor	Fair.
Sogn	Very poor.	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
Ln: Lanton	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
Mb: Martin	Good	Good	Good	Fair	Fair	Good	Poor	Poor	Good	Fair	Poor	Good.
Mc, Me: Martin	Fair	Good	Good	Fair	Fair	Good	Poor	Poor	Good	Fair	Poor	Good.
Mn: Mason	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
Nc: Newtonia	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
Nd*:												
Niotaze	Poor	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Darnell	Poor	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Os: Osage	Fair	Good	Good	Good	Good	Good	Good	Good	Good	Fair	Good	Good.
Po*. Pits												
Pr: Prue	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Sh: Sogn	Very poor.	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
St: Steedman	Poor	Poor	Poor	Good	Fair	Good	Very poor.	Very poor.	Poor	Good	Very poor.	Poor.
Sv: Stephenville	Fair	Good	Good	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.	Good.
Sw*:												
Stephenville	Poor	Good	Good	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.	Good.
Darnell	Poor	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Vd: Verdigris	Poor	Good	Good	Good	Good	Good	Poor	Fair	Fair	Good	Fair	Good.
Vf: Verdigris	Good	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Fair	Good.
Wo: Woodson	Good	Good	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ba: Bates	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Slight	Moderate: low strength.
Bb: Bates	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Moderate: low strength.
Bf: Benfield	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Cd: Catoosa	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: low strength.
Cf*:					
Catoosa	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: low strength.
Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Ck: Clime	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Cm: Clime	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Cs*:					
Clime	Moderate: depth to rock, too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.
Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Cv*:					
Collinsville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Bates	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Moderate: low strength.
De, Df, Dg: Dennis	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Dw: Dwight	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Em, En, Eo: Eram	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Es*:					
Eram	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Dwight	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Fe: Fiat	Severe: depth to rock, wetness.	Severe: wetness, shrink-swell.	Severe: wetness, depth to rock, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.
Fm*:					
Florence	Moderate: depth to rock, too clayey, large stones.	Moderate: shrink-swell, large stones.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope, large stones.	Severe: low strength.
Martin	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.
Iv, Iw: Ivan	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Kd: Kenoma	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
La: Labette	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Ld*:					
Labette	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Dwight	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Lg*:					
Labette	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Ln: Lanton	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding.
Mb, Mc, Me: Martin	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Mn---------------- Mason	Slight-----------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Nc---------------- Newtonia	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Nd*:					
Niotaze----------	Severe: wetness, slope.	Severe: wetness, shrink-swell, slope.	Severe: wetness, slope, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: low strength, slope, shrink-swell.
Darnell----------	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.
Os---------------- Osage	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, flooding.
Po*. Pits					
Pr---------------- Prue	Slight-----------	Slight-----------	Slight-----------	Moderate: slope.	Moderate: low strength.
Sh---------------- Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
St---------------- Steedman	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, slope, shrink-swell.	Severe: wetness, shrink-swell.
Sv---------------- Stephenville	Moderate: depth to rock.	Slight-----------	Moderate: depth to rock.	Slight------------	Moderate: low strength.
Sw*:					
Stephenville-----	Moderate: depth to rock.	Slight-----------	Moderate: depth to rock.	Slight------------	Moderate: low strength.
Darnell----------	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.
Vd, Vf------------ Verdigris	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Wo---------------- Woodson	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, low strength, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ba, Bb: Bates	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Bf: Benfield	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Cd: Catoosa	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
Cf*:					
Catoosa	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Ck: Clime	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
Cm: Clime	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Cs*:					
Clime	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Sogn	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Cv*:					
Collinsville	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
Bates	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
De, Df, Dg: Dennis	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Dw: Dwight	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock, too clayey, excess sodium.	Moderate: depth to rock.	Poor: too clayey, hard to pack, excess sodium.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Em, En, Eo: Eram	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, wetness.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Es*:					
Eram	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, wetness.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Dwight	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey, excess sodium.	Moderate: depth to rock.	Poor: too clayey, hard to pack, excess sodium.
Fe: Fiat	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness, too clayey.	Severe: depth to rock, wetness.	Poor: area reclaim, too clayey, hard to pack.
Fm*:					
Florence	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack, small stones.
Martin	Severe: wetness, percs slowly.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Iv, Iw: Ivan	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Kd: Kenoma	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
La: Labette	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Ld*:					
Labette	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Dwight	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock, too clayey, excess sodium.	Moderate: depth to rock.	Poor: too clayey, hard to pack, excess sodium.
Lg*:					
Labette	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ln------------------ Lanton	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness, thin layer.
Mb, Mc, Me---------- Martin	Severe: wetness, percs slowly.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Mn------------------ Mason	Severe: percs slowly.	Slight-----------	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Nc------------------ Newtonia	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Nd*:					
Niotaze------------	Severe: depth to rock, percs slowly, wetness.	Severe: slope, depth to rock, wetness.	Severe: depth to rock, wetness, slope.	Severe: slope, depth to rock, wetness.	Poor: too clayey, area reclaim, hard to pack.
Darnell------------	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
Os------------------ Osage	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
Po*. Pits					
Pr------------------ Prue	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Poor: thin layer.
Sh------------------ Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
St------------------ Steedman	Severe: percs slowly, depth to rock.	Severe: depth to rock, slope.	Severe: wetness, too clayey, depth to rock.	Severe: depth to rock, wetness.	Poor: area reclaim, too clayey, hard to pack.
Sv------------------ Stephenville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Sw*:					
Stephenville--------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Darnell------------	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
Vd, Vf-------------- Verdigris	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Wo------------------ Woodson	Severe: percs slowly, wetness.	Slight-----------	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, wetness, hard to pack.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ba, Bb: Bates	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
Bf: Benfield	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Cd: Catoosa	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer, too clayey.
Cf*:				
Catoosa	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer, too clayey.
Sogn	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Ck: Clime	Poor: area reclaim, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Cm: Clime	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
Cs*:				
Clime	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
Sogn	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Cv*:				
Collinsville	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Bates	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
De, Df, Dg: Dennis	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, thin layer.
Dw: Dwight	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Em: Eram	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
En, Eo: Eram	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey.
Es*:				
Eram	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
Dwight	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Fe: Fiat	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey.
Fm*:				
Florence	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Martin	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Iv, Iw: Ivan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Kd: Kenoma	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
La: Labette	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, thin layer.
Ld*:				
Labette	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, thin layer.
Dwight	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Lg*:				
Labette	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Sogn	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ln-------------------- Lanton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, thin layer.
Mb, Mc---------------- Martin	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Me-------------------- Martin	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Mn-------------------- Mason	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Nc-------------------- Newtonia	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
Nd*:				
Niotaze--------------	Poor: low strength, area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Darnell--------------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Os-------------------- Osage	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Po*. Pits				
Pr-------------------- Prue	Fair: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
Sh-------------------- Sogn	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
St-------------------- Steedman	Poor: wetness, shrink-swell, area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness, large stones.
Sv-------------------- Stephenville	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
Sw*:				
Stephenville---------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
Darnell--------------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Vd, Vf---------------- Verdigris	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Wo-------------------- Woodson	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
Ba: Bates	Moderate: seepage, depth to rock.	Severe: piping.	Deep to water	Soil blowing, depth to rock.	Depth to rock, soil blowing.	Depth to rock.
Bb: Bates	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
Bf: Benfield	Moderate: depth to rock, slope.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Cd: Catoosa	Moderate: seepage, depth to rock.	Severe: thin layer.	Deep to water	Depth to rock, rooting depth.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Cf*:						
Catoosa	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, rooting depth, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Sogn	Severe: depth to rock.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
Ck: Clime	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, depth to rock.	Slope, depth to rock.	Slope, depth to rock.
Cm: Clime	Moderate: depth to rock, slope.	Moderate: thin layer, hard to pack.	Deep to water	Slow intake, percs slowly, depth to rock.	Depth to rock	Depth to rock.
Cs*:						
Clime	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Slow intake, percs slowly, depth to rock.	Slope, depth to rock.	Slope, depth to rock.
Sogn	Severe: depth to rock.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
Cv*:						
Collinsville	Severe: depth to rock, seepage.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
Bates	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
De: Dennis	Slight	Moderate: hard to pack, wetness.	Percs slowly	Wetness, percs slowly, rooting depth.	Erodes easily, wetness, percs slowly.	Erodes easily, rooting depth, percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Df, Dg: Dennis	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, slope.	Wetness, percs slowly, rooting depth.	Erodes easily, wetness, percs slowly.	Erodes easily, rooting depth, percs slowly.
Dw: Dwight	Moderate: depth to rock.	Severe: excess sodium.	Deep to water	Percs slowly, erodes easily, excess sodium.	Erodes easily, percs slowly.	Excess sodium, erodes easily, percs slowly.
Em: Eram	Moderate: depth to rock.	Moderate: thin layer, hard to pack, wetness.	Percs slowly, depth to rock.	Wetness, percs slowly.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
En, Eo: Eram	Moderate: depth to rock, slope.	Moderate: thin layer, hard to pack, wetness.	Percs slowly, depth to rock, slope.	Wetness, percs slowly.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Es*:						
Eram	Moderate: depth to rock.	Moderate: thin layer, hard to pack, wetness.	Percs slowly, depth to rock.	Wetness, percs slowly.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Dwight	Moderate: depth to rock.	Severe: excess sodium.	Deep to water	Percs slowly, erodes easily, excess sodium.	Erodes easily, percs slowly.	Excess sodium, erodes easily, percs slowly.
Fe: Fiat	Moderate: depth to rock.	Moderate: thin layer, hard to pack, wetness.	Percs slowly, depth to rock.	Wetness, percs slowly.	Depth to rock, erodes easily, wetness.	Wetness, erodes easily, depth to rock.
Fm*:						
Florence	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Large stones, droughty, slope.	Large stones	Large stones, droughty.
Martin	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
Iv, Iw: Ivan	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding	Favorable	Favorable.
Kd: Kenoma	Slight	Severe: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
La: Labette	Moderate: depth to rock.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Ld*:						
Labette	Moderate: depth to rock.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Dwight	Moderate: depth to rock.	Severe: excess sodium.	Deep to water	Percs slowly, erodes easily, excess sodium.	Erodes easily, percs slowly.	Excess sodium, erodes easily, percs slowly.
Lg*:						
Labette	Moderate: depth to rock.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock.	Depth to rock, erodes easily.	Erodes easily, depth to rock.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Lg*:						
Sogn	Severe: depth to rock.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
Ln: Lanton	Slight	Severe: piping, wetness.	Percs slowly, flooding.	Wetness, percs slowly, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
Mb: Martin	Slight	Moderate: hard to pack, wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
Mc: Martin	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
Me: Martin	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Wetness, slow intake, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
Mn: Mason	Slight	Moderate: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
Nc: Newtonia	Moderate: seepage.	Moderate: hard to pack.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
Nd*:						
Niotaze	Severe: slope.	Severe: thin layer.	Percs slowly, depth to rock, slope.	Wetness, percs slowly, droughty.	Slope, large stones, depth to rock.	Slope, wetness, large stones.
Darnell	Severe: depth to rock, slope, seepage.	Severe: piping, thin layer.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Os: Osage	Slight	Severe: hard to pack, wetness.	Percs slowly, flooding.	Wetness	Wetness, percs slowly.	Wetness, percs slowly.
Po*. Pits						
Pr: Prue	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
Sh: Sogn	Severe: depth to rock.	Severe: thin layer.	Deep to water	Depth to rock	Depth to rock	Depth to rock.
St: Steedman	Severe: slope.	Severe: wetness.	Percs slowly, depth to rock, slope.	Wetness, percs slowly, slope.	Slope, wetness, depth to rock.	Slope, wetness, depth to rock.
Sv: Stephenville	Moderate: seepage, depth to rock.	Severe: thin layer.	Deep to water	Depth to rock	Depth to rock	Depth to rock.
Sw*:						
Stephenville	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Sw*:						
Darnell	Severe: depth to rock, seepage.	Severe: piping, thin layer.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
Vd, Vf Verdigris	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding	Favorable	Favorable.
Wo Woodson	Slight	Severe: wetness.	Percs slowly	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Percs slowly, wetness, erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ba--------------- Bates	0-10	Fine sandy loam	ML, SM	A-4	0	90-100	85-100	80-100	40-55	<30	NP-5
	10-32	Loam, clay loam, sandy clay loam.	ML, CL, SC, SM	A-4, A-6, A-7-6	0	85-100	85-100	80-100	45-85	25-45	3-20
	32	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Bb--------------- Bates	0-10	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	90-100	85-100	80-100	55-90	20-40	3-15
	10-26	Loam, clay loam, sandy clay loam.	ML, CL, SC, SM	A-4, A-6, A-7-6	0	85-100	85-100	80-100	45-85	25-45	3-20
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Bf--------------- Benfield	0-10	Cherty silt loam	CL	A-6, A-7-6	0-15	85-100	70-85	70-85	70-85	30-50	11-25
	10-36	Silty clay, silty clay loam, cherty silty clay.	CH, CL	A-7	0-15	85-100	70-100	70-95	70-95	40-60	20-35
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cd--------------- Catoosa	0-10	Silt loam--------	CL	A-4, A-6	0	100	100	96-100	65-97	30-37	8-14
	10-34	Silty clay loam, clay loam.	CL	A-6, A-7-6	0	85-100	85-100	85-100	70-98	33-48	12-22
	34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cf*:											
Catoosa---------	0-9	Silt loam--------	CL	A-4, A-6	0	100	100	96-100	65-97	30-37	8-14
	9-26	Silty clay loam, clay loam.	CL	A-6, A-7-6	0	85-100	85-100	85-100	70-98	33-48	12-22
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Sogn------------	0-8	Silty clay loam	CL, MH, CH	A-6, A-7	0-10	85-100	85-100	85-100	70-100	25-55	10-25
	8	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ck--------------- Clime	0-10	Stony silty clay loam.	CL, CH	A-7	5-15	90-100	90-100	85-100	80-95	40-60	20-30
	10-27	Silty clay, clay, silty clay loam.	CH, CL	A-7, A-6	0	95-100	95-100	95-100	85-95	35-60	15-35
	27-33	Silty clay, clay, shaly silty clay.	CL, CH, SC	A-7	0	75-100	55-100	50-95	40-90	45-60	20-30
	33	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cm--------------- Clime	0-10	Silty clay-------	CL, CH	A-7	0-5	90-100	90-100	85-100	80-95	40-60	15-35
	10-24	Silty clay, clay, silty clay loam.	CH, CL	A-7, A-6	0	95-100	95-100	95-100	85-95	35-60	15-35
	24-31	Silty clay, clay, shaly silty clay.	CL, CH, SC	A-7	0	75-100	55-100	50-95	40-90	45-60	20-30
	31	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Cs*:											
Clime-----------	0-10	Silty clay-------	CL, CH	A-7	0-5	90-100	90-100	85-100	80-95	40-60	15-35
	10-24	Silty clay, clay, silty clay loam.	CH, CL	A-7, A-6	0	95-100	95-100	95-100	85-95	35-60	15-35
	24-31	Silty clay, clay, shaly silty clay.	CL, CH, SC	A-7	0	75-100	55-100	50-95	40-90	45-60	20-30
	31	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Sogn------------	0-8	Silty clay loam	CL, MH, CH	A-6, A-7	0-10	85-100	85-100	85-100	70-100	25-55	10-25
	8	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cv*:											
Collinsville----	0-8	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4, A-2	0-15	85-100	85-100	75-95	30-60	<26	NP-7
	8-14	Fine sandy loam, loam, stony fine sandy loam.	SM, SC, ML, CL	A-4, A-2	0-45	55-100	55-100	50-95	20-85	<30	NP-10
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Bates-----------	0-8	Fine sandy loam	ML, SM	A-4	0	90-100	85-100	80-100	40-55	<30	NP-5
	8-28	Loam, clay loam, sandy clay loam.	ML, CL, SC, SM	A-4, A-6, A-7-6	0	85-100	85-100	80-100	45-85	25-45	3-20
	28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
De--------------- Dennis	0-12	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	65-97	20-37	1-15
	12-20	Silty clay loam, clay loam.	CL	A-6, A-7-6	0	98-100	98-100	94-100	75-98	33-48	13-25
	20-60	Clay, silty clay, silty clay loam.	CL, CH	A-7, A-6	0	98-100	98-100	94-100	75-98	37-65	15-35
Df--------------- Dennis	0-13	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	65-97	20-37	1-15
	13-20	Silty clay loam, clay loam.	CL	A-6, A-7-6	0	98-100	98-100	94-100	75-98	33-48	13-25
	20-60	Clay, silty clay, silty clay loam.	CL, CH	A-7, A-6	0	98-100	98-100	94-100	75-98	37-65	15-35
Dg--------------- Dennis	0-7	Silty clay loam	CL	A-6, A-7-6	0	100	98-100	94-100	75-98	33-48	13-25
	7-13	Silty clay loam, clay loam.	CL	A-6, A-7-6	0	98-100	98-100	94-100	75-98	33-48	13-25
	13-60	Clay, silty clay, silty clay loam.	CL, CH	A-7, A-6	0	98-100	98-100	94-100	75-98	37-65	15-35
Dw--------------- Dwight	0-4	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-100	25-40	5-15
	4-27	Clay, silty clay	CH	A-7	0	100	100	95-100	90-100	50-70	25-40
	27-42	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	90-100	45-60	25-40
	42	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Em--------------- Eram	0-10	Silt loam--------	CL	A-4, A-6	0	85-100	85-100	85-100	75-95	30-37	8-13
	10-33	Clay, silty clay, clay loam.	CL, CH	A-7, A-6	0	95-100	95-100	90-100	85-98	37-65	15-35
	33	Weathered bedrock	---	---	---	---	---	---	---	---	---

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
En---------------- Eram	0-9	Silty clay loam	CL	A-6, A-7-6	0	85-100	85-100	85-100	75-95	33-48	12-25
	9-30	Clay, silty clay, clay loam.	CL, CH	A-7, A-6	0	95-100	95-100	90-100	85-98	37-65	15-35
	30	Weathered bedrock	---	---	---	---	---	---	---	---	---
Eo---------------- Eram	0-6	Silty clay loam	CL	A-6, A-7-6	0	85-100	85-100	85-100	75-95	33-48	12-25
	6-31	Clay, silty clay, clay loam.	CL, CH	A-7, A-6	0	95-100	95-100	90-100	85-98	37-65	15-35
	31	Weathered bedrock	---	---	---	---	---	---	---	---	---
Es*:											
Eram------------	0-10	Silt loam--------	CL	A-4, A-6	0	85-100	85-100	85-100	75-95	30-37	8-13
	10-30	Clay, silty clay, clay loam.	CL, CH	A-7, A-6	0	95-100	95-100	90-100	85-98	37-65	15-35
	30	Weathered bedrock	---	---	---	---	---	---	---	---	---
Dwight----------	0-4	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-100	25-40	5-15
	4-41	Clay, silty clay	CH	A-7	0	100	100	95-100	90-100	50-70	25-40
	41	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Fe---------------- Flat	0-11	Silty clay loam	CL, CH	A-6, A-7-6	0	100	100	95-100	75-98	35-55	15-25
	11-30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Fm*:											
Florence--------	0-6	Cherty silt loam	GC, SC, CL	A-6, A-2	0-10	30-90	20-75	20-75	20-70	25-35	10-20
	6-12	Cherty silt loam, very cherty silty clay loam.	GC, SC, CL	A-6, A-2	5-20	30-75	15-70	15-70	15-65	25-35	10-20
	12-32	Very cherty silty clay, very cherty silty clay loam.	GC, SC	A-2, A-7	10-20	30-70	20-45	20-45	15-40	50-65	30-40
	32-49	Coarse cherty clay, cherty clay, very cherty clay.	GC, SC, CH	A-2, A-7	10-40	30-90	20-80	20-75	15-70	50-75	30-45
	49	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Martin----------	0-9	Silty clay loam	CL	A-6, A-7-6	0	100	100	95-100	80-100	35-45	15-25
	9-60	Silty clay, clay	CH, CL	A-7	0	100	100	95-100	80-100	40-70	25-40
Iv, Iw----------- Ivan	0-33	Silt loam--------	CL	A-4, A-6	0	95-100	95-100	90-100	70-100	25-40	7-20
	33-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6, A-7-6	0	95-100	95-100	90-100	65-100	25-45	7-25
Kd---------------- Kenoma	0-8	Silt loam--------	CL, CL-ML, ML	A-4, A-6	0	85-100	85-100	85-100	85-100	25-40	3-18
	8-50	Silty clay, clay	CH	A-7	0	85-100	85-100	85-100	85-100	50-75	30-48
	50-60	Silty clay, silty clay loam.	CL, CH	A-7	0	85-100	85-100	75-100	75-95	45-65	25-44

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
La--------------- Labette	0-9	Silty clay loam	CL	A-6, A-7-6	0	85-100	85-100	85-100	85-100	30-50	10-25
	9-30	Silty clay, silty clay loam, cherty silty clay.	CH, CL	A-7-6	0-20	75-100	70-100	65-100	60-100	40-60	20-35
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ld*:											
Labette----------	0-9	Silty clay loam	CL	A-6, A-7-6	0	85-100	85-100	85-100	85-100	30-50	10-25
	9-30	Silty clay, silty clay loam, cherty silty clay.	CH, CL	A-7-6	0-20	75-100	70-100	65-100	60-100	40-60	20-35
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Dwight-----------	0-4	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-100	25-40	5-15
	4-27	Clay, silty clay	CH	A-7	0	100	100	95-100	90-100	50-70	25-40
	27-42	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	90-100	45-60	25-40
	42	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Lg*:											
Labette----------	0-9	Silty clay loam	CL	A-6, A-7-6	0	85-100	85-100	85-100	85-100	30-50	10-25
	9-26	Silty clay, silty clay loam, cherty silty clay.	CH, CL	A-7	0-20	75-100	70-100	65-100	60-100	40-60	20-35
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Sogn-------------	0-8	Silty clay loam	CL, MH, CH	A-6, A-7	0-10	85-100	85-100	85-100	70-100	25-55	10-25
	8	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ln--------------- Lanton	0-7	Silty clay loam	CL, CL-ML	A-4, A-6	0	100	95-100	90-100	80-95	25-38	6-15
	7-36	Silt loam, silty clay loam.	CL	A-4, A-6	0	100	95-100	85-100	80-95	30-38	8-16
	36-60	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	95-100	85-100	75-95	40-55	18-28
Mb--------------- Martin	0-12	Silty clay loam	CL	A-6, A-7-6	0	100	100	95-100	80-100	35-45	15-25
	12-60	Silty clay, clay	CH, CL	A-7	0	100	100	95-100	80-100	40-70	25-40
Mc--------------- Martin	0-9	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	80-100	35-45	15-25
	9-60	Silty clay, clay	CH, CL	A-7	0	100	100	95-100	80-100	40-70	25-40
Me--------------- Martin	0-7	Silty clay-------	CH, CL	A-7	0	100	100	95-100	80-100	40-70	25-40
	7-60	Silty clay, clay	CH, CL	A-7	0	100	100	95-100	80-100	40-70	25-40
Mn--------------- Mason	0-14	Silt loam--------	CL	A-4, A-6	0	100	100	96-100	65-98	30-37	8-13
	14-60	Silty clay loam, clay loam, silt loam.	CL	A-6, A-4, A-7	0	98-100	98-100	96-100	65-98	30-43	9-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Nc---------------- Newtonia	0-12	Silt loam--------	CL	A-4, A-6	0	100	100	96-100	65-97	30-37	9-14
	12-18	Silt loam, silty clay loam.	CL	A-4, A-6	0	100	100	96-100	80-98	30-40	9-16
	18-26	Silty clay loam	CL	A-6, A-7-6	0	100	100	98-100	90-98	33-42	12-19
	26-60	Silty clay loam, silty clay, clay.	CL, CH	A-6, A-7	0	100	100	96-100	90-98	37-60	15-34
Nd*: Niotaze---------	0-7	Cobbly loam------	SM, GM, ML, CL	A-2, A-4	25-50	50-75	50-75	40-75	25-70	<31	NP-10
	7-30	Silty clay, silty clay loam, clay.	CH, CL	A-7, A-6	0	95-100	95-100	90-100	90-100	35-65	15-40
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Darnell---------	0-4	Fine sandy loam	SM, SC, ML, CL	A-4, A-2	0-15	90-100	90-100	85-100	30-60	<30	NP-10
	4-12	Fine sandy loam, loam, gravelly fine sandy loam.	SM, SC, ML, CL	A-4, A-2	0-10	70-100	70-100	60-100	25-60	<30	NP-10
	12	Weathered bedrock	---	---	---	---	---	---	---	---	---
Os---------------- Osage	0-11	Silty clay loam	CL	A-7-6	0	100	100	100	95-100	40-50	20-30
	11-60	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	100	95-100	40-80	20-50
Po*. Pits											
Pr---------------- Prue	0-11	Fine sandy loam	SM-SC, SM	A-4	0	100	98-100	90-100	36-50	<26	NP-7
	11-48	Loam, clay loam, sandy clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-85	25-35	7-15
	48-60	Silty clay, silty clay loam, clay loam.	CL, CH	A-6, A-7	0	70-100	70-100	65-100	65-99	35-60	15-35
Sh---------------- Sogn	0-8	Silty clay loam	CL, MH, CH	A-6, A-7	0-10	85-100	85-100	85-100	70-100	25-55	10-25
	8	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
St---------------- Steedman	0-7	Stony loam-------	CL	A-4, A-6	25-65	75-100	75-100	70-100	51-98	30-37	8-14
	7-36	Clay, silty clay	CL, CH	A-7	0	98-100	95-100	95-100	90-99	41-70	20-40
	36	Weathered bedrock	---	---	---	---	---	---	---	---	---
Sv---------------- Stephenville	0-11	Fine sandy loam	SM, SC, ML, CL	A-4	0-15	85-100	85-100	80-100	36-60	<30	NP-10
	11-32	Fine sandy loam, sandy clay loam.	SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	20-37	7-16
	32	Weathered bedrock	---	---	---	---	---	---	---	---	---
Sw*: Stephenville----	0-11	Fine sandy loam	SM, SC, ML, CL	A-4	0-15	85-100	85-100	80-100	36-60	<30	NP-10
	11-32	Fine sandy loam, sandy clay loam.	SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	20-37	7-16
	32	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Sw*:											
Darnell----------	0-4	Fine sandy loam	SM, SC, ML, CL	A-4, A-2	0-15	90-100	90-100	85-100	30-60	<30	NP-10
	4-12	Fine sandy loam, loam, gravelly fine sandy loam.	SM, SC, ML, CL	A-4, A-2	0-10	70-100	70-100	60-100	25-60	<30	NP-10
	12	Weathered bedrock	---	---	---	---	---	---	---	---	---
Vd---------------- Verdigris	0-17	Silt loam--------	CL, CL-ML, ML	A-4, A-6	0	100	100	95-100	65-100	22-38	2-13
	17-60	Silt loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	100	95-100	80-100	30-45	8-23
Vf---------------- Verdigris	0-7	Silt loam--------	CL, CL-ML, ML	A-4, A-6	0	100	100	95-100	65-100	22-38	2-13
	7-60	Silt loam, silty clay loam.	CL	A-4, A-6, A-7-6	0	100	100	95-100	80-100	30-45	8-23
Wo---------------- Woodson	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	85-100	25-40	5-20
	8-46	Silty clay, clay	CH	A-7	0	100	95-100	95-100	90-100	50-65	30-45
	46-60	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	95-100	95-100	90-100	45-65	20-40

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ba: Bates	0-10	5-15	1.50-1.60	2.0-6.0	0.15-0.18	5.1-6.5	<2	Low	0.20	4	3	1-2
	10-32	18-35	1.50-1.60	0.6-2.0	0.15-0.19	5.1-6.5	<2	Low	0.28			
	32	---	---	---	---	---	---	---	---			
Bb: Bates	0-10	15-27	1.40-1.50	0.6-2.0	0.20-0.24	5.1-6.5	<2	Low	0.28	4	6	1-4
	10-26	18-35	1.50-1.60	0.6-2.0	0.15-0.19	5.1-6.5	<2	Low	0.28			
	26	---	---	---	---	---	---	---	---			
Bf: Benfield	0-10	20-35	1.30-1.40	0.2-2.0	0.17-0.22	6.1-7.8	<2	Moderate	0.28	3	8	---
	10-36	35-45	1.35-1.45	0.06-0.2	0.18-0.22	6.6-8.4	<2	High	0.37			
	36	---	---	---	---	---	---	---	---			
Cd: Catoosa	0-10	15-26	1.30-1.55	0.6-2.0	0.15-0.24	5.6-6.5	<2	Low	0.37	3	6	1-3
	10-34	27-39	1.45-1.70	0.6-2.0	0.15-0.22	5.1-7.3	<2	Moderate	0.32			
	34	---	---	---	---	---	---	---	---			
Cf*:												
Catoosa	0-9	15-26	1.30-1.55	0.6-2.0	0.15-0.24	5.6-6.5	<2	Low	0.37	3	6	1-3
	9-26	27-39	1.45-1.70	0.6-2.0	0.15-0.22	5.1-7.3	<2	Moderate	0.32			
	26	---	---	---	---	---	---	---	---			
Sogn	0-8	27-35	1.15-1.20	0.6-2.0	0.17-0.22	6.1-8.4	<2	Moderate	0.32	1	4L	---
	8	---	---	---	---	---	---	---	---			
Ck: Clime	0-10	35-50	1.35-1.45	0.06-0.6	0.10-0.18	6.6-8.4	<2	Moderate	0.20	3	8	1-4
	10-27	35-60	1.35-1.50	0.06-0.2	0.12-0.18	7.4-8.4	<2	Moderate	0.28			
	27-33	35-50	1.40-1.50	0.06-0.2	0.10-0.14	7.4-8.4	<2	Moderate	0.28			
	33	---	---	---	---	---	---	---	---			
Cm: Clime	0-10	40-50	1.35-1.45	0.06-0.2	0.12-0.14	6.6-8.4	<2	Moderate	0.28	3	4	1-4
	10-24	35-60	1.35-1.50	0.06-0.2	0.12-0.18	7.4-8.4	<2	Moderate	0.28			
	24-31	35-50	1.40-1.50	0.06-0.2	0.10-0.14	7.4-8.4	<2	Moderate	0.28			
	31	---	---	---	---	---	---	---	---			
Cs*:												
Clime	0-10	40-50	1.35-1.45	0.06-0.2	0.12-0.14	6.6-8.4	<2	Moderate	0.28	3	4	1-4
	10-24	35-60	1.35-1.50	0.06-0.2	0.12-0.18	7.4-8.4	<2	Moderate	0.28			
	24-31	35-50	1.40-1.50	0.06-0.2	0.10-0.14	7.4-8.4	<2	Moderate	0.28			
	31	---	---	---	---	---	---	---	---			
Sogn	0-8	27-35	1.15-1.20	0.6-2.0	0.17-0.22	6.1-8.4	<2	Moderate	0.32	1	4L	---
	8	---	---	---	---	---	---	---	---			
Cv*:												
Collinsville	0-8	5-20	1.30-1.60	2.0-6.0	0.09-0.15	4.5-6.5	<2	Low	0.20	1	3	1-3
	8-14	5-20	1.40-1.70	2.0-6.0	0.07-0.20	4.5-6.5	<2	Low	0.28			
	14	---	---	---	---	---	---	---	---			
Bates	0-8	5-15	1.50-1.60	2.0-6.0	0.15-0.18	5.1-6.5	<2	Low	0.20	4	3	1-2
	8-28	18-35	1.50-1.60	0.6-2.0	0.15-0.19	5.1-6.5	<2	Low	0.28			
	28	---	---	---	---	---	---	---	---			
De: Dennis	0-12	10-27	1.30-1.55	0.6-2.0	0.15-0.20	5.1-6.0	<2	Low	0.43	4	6	1-3
	12-20	27-35	1.45-1.70	0.2-0.6	0.15-0.20	4.5-6.0	<2	Moderate	0.37			
	20-60	35-55	1.35-1.65	0.06-0.2	0.15-0.20	5.1-8.4	<2	High	0.37			
Df: Dennis	0-13	10-27	1.30-1.55	0.6-2.0	0.15-0.20	5.1-6.0	<2	Low	0.43	4	7	1-3
	13-20	27-35	1.45-1.70	0.2-0.6	0.15-0.20	4.5-6.0	<2	Moderate	0.37			
	20-60	35-55	1.35-1.65	0.06-0.2	0.15-0.20	5.1-8.4	<2	High	0.37			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Dg---------------- Dennis	0-7	27-35	1.30-1.60	0.2-0.6	0.15-0.20	5.1-6.0	<2	Moderate	0.37	4	7	1-3
	7-13	27-35	1.45-1.70	0.2-0.6	0.15-0.20	4.5-6.0	<2	Moderate	0.37			
	13-60	35-55	1.35-1.65	0.06-0.2	0.15-0.20	5.1-8.4	<2	High------	0.37			
Dw---------------- Dwight	0-4	18-30	1.20-1.35	0.6-2.0	0.21-0.24	5.6-7.3	<2	Low-------	0.43	3	6	2-4
	4-27	45-60	1.30-1.40	<0.06	0.10-0.14	6.1-8.4	<4	High------	0.32			
	27-42	35-50	1.30-1.40	0.06-0.2	0.10-0.15	6.6-8.4	<8	High------	0.32			
	42	---	---	---	---	---	---	----------	----			
Em---------------- Eram	0-10	18-27	1.30-1.50	0.2-2.0	0.16-0.24	5.6-6.5	<2	Low-------	0.37	3	7	1-3
	10-33	35-55	1.45-1.75	0.06-0.2	0.14-0.18	5.1-7.3	<2	High------	0.37			
	33	---	---	---	---	---	---	----------	----			
En---------------- Eram	0-9	27-40	1.30-1.60	0.2-0.6	0.15-0.19	5.6-6.5	<2	Moderate	0.37	3	7	1-3
	9-30	35-55	1.45-1.75	0.06-0.2	0.14-0.18	5.1-7.3	<2	High------	0.37			
	30	---	---	---	---	---	---	----------	----			
Eo---------------- Eram	0-6	27-40	1.30-1.60	0.2-0.6	0.15-0.19	5.6-6.5	<2	Moderate	0.37	3	7	1-3
	6-31	35-55	1.45-1.75	0.06-0.2	0.14-0.18	5.1-7.3	<2	High------	0.37			
	31	---	---	---	---	---	---	----------	----			
Es*:												
Eram------------	0-10	18-27	1.30-1.50	0.2-2.0	0.16-0.24	5.6-6.5	<2	Low-------	0.43	3	6	1-3
	10-30	35-55	1.45-1.75	0.06-0.2	0.14-0.18	5.1-7.3	<2	High------	0.37			
	30	---	---	---	---	---	---	----------	----			
Dwight----------	0-4	18-30	1.20-1.35	0.6-2.0	0.21-0.24	5.6-7.3	<2	Low-------	0.43	3	6	2-4
	4-41	45-60	1.30-1.40	<0.06	0.10-0.14	6.1-8.4	<4	High------	0.32			
	41	---	---	---	---	---	---	----------	----			
Fe---------------- Fiat	0-11	30-45	1.30-1.50	0.2-0.6	0.12-0.23	5.6-6.5	<2	Moderate	0.37	3	7	1-3
	11-30	---	---	---	---	---	---	----------	----			
Fm*:												
Florence---------	0-6	24-35	1.25-1.35	0.6-2.0	0.05-0.20	5.6-7.3	<2	Low-------	0.24	3	8	2-4
	6-12	24-35	1.35-1.45	0.6-2.0	0.03-0.20	5.6-7.3	<2	Low-------	0.24			
	12-32	35-55	1.35-1.55	0.2-0.6	0.03-0.11	5.6-7.3	<2	Moderate	0.24			
	32-49	50-80	1.35-1.60	0.2-0.6	0.03-0.12	6.1-7.8	<2	Moderate	0.24			
	49	---	---	---	---	---	---	----------	----			
Martin----------	0-9	27-40	1.35-1.40	0.2-0.6	0.21-0.23	5.6-6.5	<2	Moderate	0.37	4	7	2-4
	9-60	40-55	1.40-1.50	0.06-0.2	0.12-0.18	5.6-7.8	<2	High------	0.37			
Iv, Iw----------- Ivan	0-33	16-27	1.30-1.45	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low-------	0.32	5	4L	2-4
	33-60	18-35	1.35-1.55	0.6-2.0	0.19-0.22	7.9-8.4	<2	Moderate	0.32			
Kd---------------- Kenoma	0-8	18-27	1.35-1.45	0.2-0.6	0.22-0.24	5.1-6.5	<2	Low-------	0.43	4	6	2-4
	8-50	40-60	1.40-1.50	<0.06	0.10-0.15	5.1-7.8	<2	High------	0.32			
	50-60	30-50	1.35-1.45	0.06-0.2	0.10-0.20	6.1-8.4	<4	High------	0.32			
La---------------- Labette	0-9	28-35	1.35-1.45	0.2-0.6	0.21-0.23	5.6-6.5	<2	Moderate	0.37	3	7	2-4
	9-30	35-50	1.40-1.50	0.06-0.2	0.12-0.19	5.6-8.4	<2	High------	0.37			
	30	---	---	---	---	---	---	----------	----			
Ld*:												
Labette---------	0-9	28-35	1.35-1.45	0.2-0.6	0.21-0.23	5.6-6.5	<2	Moderate	0.37	3	7	2-4
	9-30	35-50	1.40-1.50	0.06-0.2	0.12-0.19	5.6-8.4	<2	High------	0.37			
	30	---	---	---	---	---	---	----------	----			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors		Wind erodi- bility group	Organic matter
									K	T		
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ld*:												
Dwight----------	0-4	18-30	1.20-1.35	0.6-2.0	0.21-0.24	5.6-7.3	<2	Low--------	0.43	3	6	2-4
	4-27	45-60	1.30-1.40	<0.06	0.10-0.14	6.1-8.4	<4	High------	0.32			
	27-42	35-50	1.30-1.40	0.06-0.2	0.10-0.15	6.6-8.4	<8	High------	0.32			
	42	---	---	---	---	---	---	----------	----			
Lg*:												
Labette---------	0-9	28-35	1.35-1.45	0.2-0.6	0.21-0.23	5.6-6.5	<2	Moderate	0.37	3	7	2-4
	9-26	35-50	1.40-1.50	0.06-0.2	0.12-0.19	5.6-8.4	<2	High------	0.37			
	26	---	---	---	---	---	---	----------	----			
Sogn------------	0-8	27-35	1.15-1.20	0.6-2.0	0.17-0.22	6.1-8.4	<2	Moderate	0.32	1	4L	---
	8	---	---	---	---	---	---	----------	----			
Ln--------------- Lanton	0-7	20-30	1.30-1.55	0.6-2.0	0.18-0.22	6.1-7.3	<2	Low--------	0.32	5	7	2-6
	7-36	20-35	1.40-1.60	0.2-0.6	0.17-0.22	6.1-7.3	<2	Low--------	0.43			
	36-60	30-50	1.40-1.60	0.06-0.6	0.12-0.18	6.1-7.3	<2	Moderate	0.32			
Mb--------------- Martin	0-12	27-40	1.35-1.40	0.2-0.6	0.21-0.23	5.6-6.5	<2	Moderate	0.37	4	7	2-4
	12-60	40-55	1.40-1.50	0.06-0.2	0.12-0.18	5.6-7.8	<2	High------	0.37			
Mc--------------- Martin	0-9	27-40	1.35-1.40	0.2-0.6	0.21-0.23	5.6-6.5	<2	Moderate	0.37	4	7	2-4
	9-60	40-55	1.40-1.50	0.06-0.2	0.12-0.18	5.6-7.8	<2	High------	0.37			
Me--------------- Martin	0-7	40-50	1.35-1.45	0.06-0.2	0.12-0.18	5.6-6.5	<2	High------	0.37	4	4	1-2
	7-60	40-55	1.40-1.50	0.06-0.2	0.12-0.18	5.6-7.8	<2	High------	0.37			
Mn--------------- Mason	0-14	12-27	1.30-1.50	0.6-2.0	0.16-0.20	5.1-7.3	<2	Low--------	0.37	5	6	1-3
	14-60	20-35	1.40-1.70	0.2-0.6	0.16-0.20	4.5-7.8	<2	Moderate	0.37			
Nc--------------- Newtonia	0-12	10-24	1.30-1.55	0.6-2.0	0.15-0.24	5.6-6.5	<2	Low--------	0.32	5	6	1-3
	12-18	20-35	1.40-1.70	0.6-2.0	0.16-0.22	5.1-6.5	<2	Moderate	0.37			
	18-26	27-35	1.45-1.70	0.6-2.0	0.18-0.22	5.1-6.0	<2	Moderate	0.32			
	26-60	32-45	1.35-1.65	0.6-2.0	0.12-0.20	5.1-6.0	<2	Moderate	0.32			
Nd*:												
Niotaze---------	0-7	10-25	1.30-1.40	0.6-6.0	0.07-0.18	5.1-6.0	<2	Low--------	0.20	3	8	---
	7-30	35-55	1.35-1.45	0.06-0.2	0.10-0.20	4.5-7.3	<2	High------	0.28			
	30	---	---	---	---	---	---	----------	----			
Darnell---------	0-4	10-20	1.30-1.65	2.0-6.0	0.12-0.16	5.1-7.3	<2	Low--------	0.24	2	3	<1
	4-12	10-25	1.40-1.70	2.0-6.0	0.12-0.16	5.1-7.3	<2	Low--------	0.32			
	12	---	---	---	---	---	---	----------	----			
Os--------------- Osage	0-11	35-40	1.45-1.65	<0.06	0.21-0.23	5.1-7.3	<2	High------	0.37	5	7	1-4
	11-60	35-60	1.50-1.70	<0.06	0.08-0.12	5.6-7.8	<2	Very high	0.28			
Po*. Pits												
Pr--------------- Prue	0-11	10-18	1.30-1.60	2.0-6.0	0.11-0.15	5.1-6.5	<2	Low--------	0.24	5	7	.5-1
	11-48	25-35	1.45-1.70	0.6-2.0	0.12-0.20	5.1-6.5	<2	Low--------	0.32			
	48-60	25-45	1.35-1.65	0.2-0.6	0.14-0.20	5.1-8.4	<2	High------	0.32			
Sh--------------- Sogn	0-8	27-35	1.15-1.20	0.6-2.0	0.17-0.22	6.1-8.4	<2	Moderate	0.32	1	4L	---
	8	---	---	---	---	---	---	----------	----			
St--------------- Steedman	0-7	18-26	1.30-1.50	0.6-2.0	0.12-0.22	5.1-6.5	<2	Low--------	0.17	3	8	.5-3
	7-36	40-55	1.35-1.60	0.06-0.2	0.10-0.18	5.6-8.4	<2	High------	0.32			
	36	---	---	---	---	---	---	----------	----			
Sv--------------- Stephenville	0-11	10-20	1.30-1.60	2.0-6.0	0.11-0.15	5.1-6.5	<2	Low--------	0.24	4	3	<1
	11-32	18-35	1.50-1.70	0.6-2.0	0.11-0.17	4.5-6.0	<2	Low--------	0.32			
	32	---	---	---	---	---	---	----------	----			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Sw*:												
Stephenville----	0-11	10-20	1.30-1.60	2.0-6.0	0.11-0.15	5.1-6.5	<2	Low-------	0.24	4	3	<1
	11-32	18-35	1.50-1.70	0.6-2.0	0.11-0.17	4.5-6.0	<2	Low-------	0.32			
	32	---	---	---	---	---	---	----------	----			
Darnell---------	0-4	10-20	1.30-1.65	2.0-6.0	0.12-0.16	5.1-7.3	<2	Low-------	0.24	2	3	<1
	4-12	10-25	1.40-1.70	2.0-6.0	0.12-0.16	5.1-7.3	<2	Low-------	0.32			
	12	---	---	---	---	---	---	----------	----			
Vd--------------- Verdigris	0-17	15-27	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.3	<2	Low-------	0.32	5	6	2-4
	17-60	18-35	1.40-1.65	0.6-2.0	0.17-0.22	5.6-7.3	<2	Moderate	0.32			
Vf--------------- Verdigris	0-7	15-27	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.3	<2	Low-------	0.32	5	6	2-4
	7-60	18-35	1.40-1.65	0.6-2.0	0.17-0.22	5.6-7.3	<2	Moderate	0.32			
Wo--------------- Woodson	0-8	18-27	1.25-1.45	0.2-0.6	0.22-0.24	5.6-6.5	<2	Low-------	0.43	4	6	1-4
	8-46	40-60	1.30-1.45	<0.06	0.12-0.15	5.6-7.3	<2	High------	0.32			
	46-60	30-50	1.35-1.45	0.06-0.2	0.10-0.15	5.6-7.8	<2	High------	0.32			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "occasional," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
Ba, Bb: Bates	B	None	---	---	>6.0	---	---	20-40	Soft	Low	Moderate.
Bf: Benfield	C	None	---	---	>6.0	---	---	20-40	Soft	High	Low.
Cd: Catoosa	B	None	---	---	>6.0	---	---	20-40	Hard	Moderate	Moderate.
Cf*:											
Catoosa	B	None	---	---	>6.0	---	---	20-40	Hard	Moderate	Moderate.
Sogn	D	None	---	---	>6.0	---	---	4-20	Hard	Low	Low.
Ck, Cm: Clime	C	None	---	---	>6.0	---	---	20-40	Soft	High	Low.
Cs*:											
Clime	C	None	---	---	>6.0	---	---	20-40	Soft	High	Low.
Sogn	D	None	---	---	>6.0	---	---	4-20	Hard	Low	Low.
Cv*:											
Collinsville	D	None	---	---	>6.0	---	---	4-20	Hard	Low	Moderate.
Bates	B	None	---	---	>6.0	---	---	20-40	Soft	Low	Moderate.
De, Df, Dg: Dennis	C	None	---	---	2.0-3.0	Perched	Dec-Apr	>60	---	High	Moderate.
Dw: Dwight	D	None	---	---	>6.0	---	---	40-60	Hard	High	Moderate.
Em, En, Eo: Eram	C	None	---	---	2.0-3.0	Perched	Dec-Apr	20-40	Soft	High	Moderate.
Es*:											
Eram	C	None	---	---	2.0-3.0	Perched	Dec-Apr	20-40	Soft	High	Moderate.
Dwight	D	None	---	---	>6.0	---	---	40-60	Hard	High	Moderate.
Fe: Fiat	C	None	---	---	1.0-2.0	Perched	Dec-Apr	20-40	Hard	High	Low.
Fm*:											
Florence	C	None	---	---	>6.0	---	---	40-60	Hard	Moderate	Low.
Martin	C	None	---	---	2.0-3.0	Perched	Dec-Apr	>60	---	High	Low.
Iv: Ivan	B	Frequent	Very brief	Dec-Jun	>6.0	---	---	>60	---	Low	Low.
Iw: Ivan	B	Occasional	Very brief	Dec-Jun	>6.0	---	---	>60	---	Low	Low.
Kd: Kenoma	D	None	---	---	>6.0	---	---	>60	---	High	Moderate.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In			
La----------------- Labette	C	None--------	---	---	>6.0	---	---	20-40	Hard	High-----	Low.
Ld*:											
Labette----------	C	None--------	---	---	>6.0	---	---	20-40	Hard	High-----	Low.
Dwight-----------	D	None--------	---	---	>6.0	---	---	40-60	Hard	High-----	Moderate.
Lg*:											
Labette----------	C	None--------	---	---	>6.0	---	---	20-40	Hard	High-----	Low.
Sogn-------------	D	None--------	---	---	>6.0	---	---	4-20	Hard	Low------	Low.
Ln---------------- Lanton	D	Occasional	Very brief	Jan-May	1.0-2.0	Apparent	Dec-May	>60	---	High-----	Low.
Mb, Mc, Me-------- Martin	C	None--------	---	---	2.0-3.0	Perched	Dec-Apr	>60	---	High-----	Low.
Mn---------------- Mason	B	Rare---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
Nc---------------- Newtonia	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
Nd*:											
Niotaze----------	C	None--------	---	---	1.0-2.0	Perched	Nov-Jun	20-40	Soft	High-----	Moderate.
Darnell----------	C	None--------	---	---	>6.0	---	---	10-20	Soft	Low------	Moderate.
Os---------------- Osage	D	Occasional	Very brief to long.	Nov-May	0-1.0	Apparent	Nov-May	>60	---	High-----	Moderate.
Po*. Pits											
Pr---------------- Prue	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate.
Sh---------------- Sogn	D	None--------	---	---	>6.0	---	---	4-20	Hard	Low------	Low.
St---------------- Steedman	C	None--------	---	---	0.5-1.0	Perched	Nov-Mar	20-40	Soft	Moderate	Moderate.
Sv---------------- Stephenville	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate.
Sw*:											
Stephenville-----	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate.
Darnell----------	C	None--------	---	---	>6.0	---	---	10-20	Soft	Low------	Moderate.
Vd---------------- Verdigris	B	Frequent----	Very brief	Dec-Jun	>6.0	---	---	>60	---	Low------	Low.
Vf---------------- Verdigris	B	Occasional	Very brief	Dec-Jun	>6.0	---	---	>60	---	Low------	Low.
Wo---------------- Woodson	D	None--------	---	---	0.5-2.0	Perched	Dec-Apr	>60	---	High-----	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--ENGINEERING INDEX TEST DATA

[LL means liquid limit; PI, plasticity index; MD, maximum dry density; and OM, optimum moisture]

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution							LL	PI	Moisture density	
			Percentage passing sieve--				Percentage smaller than--						
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			MD	OM
										Pct		Lb/ft3	Pct
Catoosa silt loam: (S81KS-049-002)													
A------ 0 to 10	A-7-6	ML	100	100	98	86	57	33	25	43	15	92	22
Bt1---- 16 to 27	A-7-6	CH	100	100	98	90	70	50	43	50	21	91	27
Steedman stony loam: (S81KS-049-001)													
A------ 0 to 7	A-6	CL	100	100	96	57	31	16	12	31	10	105	17
Bt2---- 18 to 27	A-7-5	CH	100	100	99	96	86	71	62	67	34	90	28
Stephenville fine sandy loam: (S81KS-049-003)													
A------ 0 to 6	A-2	SM	100	100	99	30	16	7	5	20	1	108	14
Bt----- 11 to 28	A-6	CL	100	100	99	47	37	31	29	33	13	104	19

TABLE 19.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Bates	Fine-loamy, siliceous, thermic Typic Argiudolls
Benfield	Fine, mixed, mesic Udic Argiustolls
Catoosa	Fine-silty, mixed, thermic Typic Argiudolls
Clime	Fine, mixed, mesic Udorthentic Haplustolls
Collinsville	Loamy, siliceous, thermic Lithic Hapludolls
Darnell	Loamy, siliceous, thermic, shallow Udic Ustochrepts
Dennis	Fine, mixed, thermic Aquic Paleudolls
Dwight	Fine, montmorillonitic, mesic Typic Natrustolls
Eram	Fine, mixed, thermic Aquic Argiudolls
Fiat	Fine, montmorillonitic, thermic Vertic Argiaquolls
Florence	Clayey-skeletal, montmorillonitic, mesic Udic Argiustolls
Ivan	Fine-silty, mixed, mesic Cumulic Hapludolls
Kenoma	Fine, montmorillonitic, thermic Vertic Argiudolls
Labette	Fine, mixed, mesic Udic Argiustolls
Lanton	Fine-silty, mixed, thermic Cumulic Haplaquolls
Martin	Fine, montmorillonitic, mesic Aquic Argiudolls
Mason	Fine-silty, mixed, thermic Typic Argiudolls
Newtonia	Fine-silty, mixed, thermic Typic Paleudolls
Niotaze	Fine, montmorillonitic, thermic Aquic Paleustalfs
Osage	Fine, montmorillonitic, thermic Vertic Haplaquolls
Prue	Fine-loamy, siliceous, thermic Mollic Paleudalfs
Sogn	Loamy, mixed, mesic Lithic Haplustolls
Steedman	Fine, montmorillonitic, thermic Vertic Haplustalfs
Stephenville	Fine-loamy, siliceous, thermic Ultic Haplustalfs
Verdigris	Fine-silty, mixed, thermic Cumulic Hapludolls
Woodson	Fine, montmorillonitic, thermic Abruptic Argiaquolls

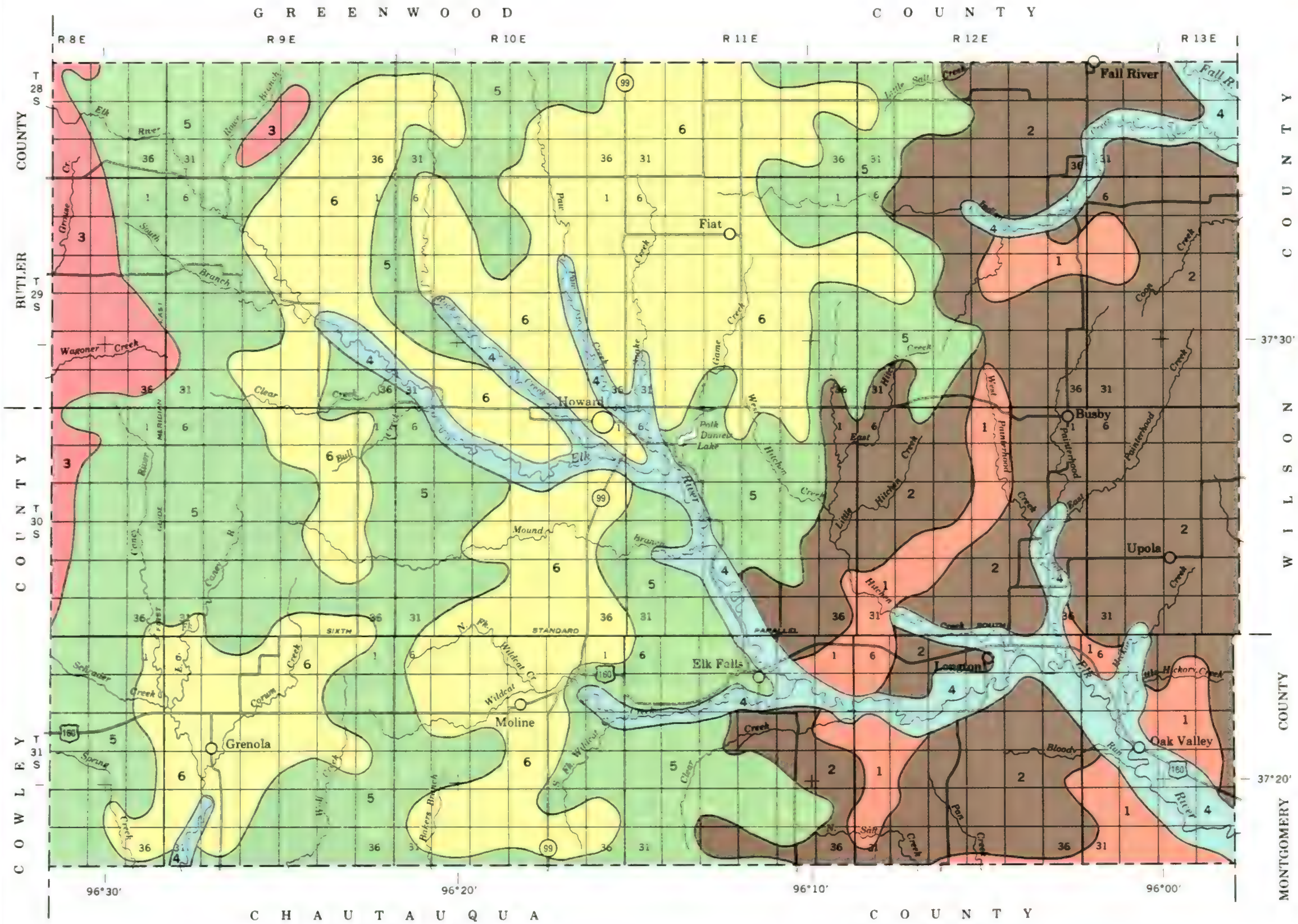
INTERPRETIVE GROUPS

Map symbol	Map unit	Land capability*	Prime farmland*	Range site
Ba	Bates fine sandy loam, 1 to 4 percent slopes	IIe	Yes	Loamy Upland.
Bb	Bates loam, 4 to 7 percent slopes	IIIe	Yes	Loamy Upland.
Bf	Benfield cherty silt loam, 4 to 10 percent slopes	VIe	No	Loamy Upland.
Cd	Catoosa silt loam, 0 to 2 percent slopes	IIe	Yes	Loamy Upland.
Cf	Catoosa-Sogn complex, 0 to 8 percent slopes	VIe	No	
	Catoosa			Loamy Upland.
	Sogn			Shallow Limy.
Ck	Clime stony silty clay loam, 20 to 30 percent slopes	VIIe	No	Limy Upland.
Cm	Clime silty clay, 3 to 7 percent slopes	IVe	No	Limy Upland.
Cs	Clime-Sogn complex, 5 to 20 percent slopes	VIe	No	
	Clime			Limy Upland.
	Sogn			Shallow Limy.
Cv	Collinsville-Bates fine sandy loams, 2 to 8 percent slopes	VIe	No	
	Collinsville			Shallow Sandstone.
	Bates			Loamy Upland.
De	Dennis silt loam, 1 to 4 percent slopes	IIe	Yes	Loamy Upland.
Df	Dennis silt loam, 4 to 7 percent slopes	IIIe	Yes	Loamy Upland.
Dg	Dennis silty clay loam, 3 to 7 percent slopes, eroded	IVe	Yes	Loamy Upland.
Dw	Dwight silt loam, 0 to 2 percent slopes	IVs	No	Claypan.
Em	Eram silt loam, 1 to 4 percent slopes	IIIe	Yes	Loamy Upland.
En	Eram silty clay loam, 4 to 7 percent slopes	IVe	No	Clay Upland.
Eo	Eram silty clay loam, 3 to 7 percent slopes, eroded	IVe	No	Clay Upland.
Es	Eram-Dwight silt loams, 1 to 4 percent slopes	IVe	No	
	Eram			Loamy Upland.
	Dwight			Claypan.
Fe	Fiat silty clay loam, 1 to 3 percent slopes	IIIe	Yes**	Clay Upland.
Fm	Florence-Martin complex, 2 to 12 percent slopes	VIe	No	Loamy Upland.
Iv	Ivan silt loam, channeled	Vw	No	Loamy Lowland.
Iw	Ivan silt loam, occasionally flooded	IIw	Yes	Loamy Lowland.
Kd	Kenoma silt loam, 1 to 3 percent slopes	IIIe	Yes	Clay Upland.
La	Labette silty clay loam, 1 to 4 percent slopes	IIe	Yes	Loamy Upland.
Ld	Labette-Dwight complex, 0 to 3 percent slopes	IIIe	No	
	Labette			Loamy Upland.
	Dwight			Claypan.
Lg	Labette-Sogn silty clay loams, 0 to 8 percent slopes	VIe	No	
	Labette			Loamy Upland.
	Sogn			Shallow Limy.
Ln	Lanton silty clay loam, occasionally flooded	IIw	Yes**	Loamy Lowland.
Mb	Martin silty clay loam, 1 to 4 percent slopes	IIe	Yes	Loamy Upland.
Mc	Martin silty clay loam, 4 to 7 percent slopes	IIIe	Yes	Loamy Upland.
Me	Martin silty clay, 3 to 7 percent slopes, eroded	IVe	No	Loamy Upland.
Mn	Mason silt loam	I	Yes	Loamy Lowland.
Nc	Newtonia silt loam, 1 to 3 percent slopes	IIe	Yes	Loamy Upland.
Nd	Niotaze-Darnell complex, 6 to 35 percent slopes	VIe	No	
	Niotaze			Savannah.
	Darnell			Shallow Savannah.
Os	Osage silty clay loam, occasionally flooded	IIw	Yes**	Loamy Lowland.
Po	Pits, quarries.			
Pr	Prue fine sandy loam, 2 to 6 percent slopes	IIIe	Yes	Loamy Upland.
Sh	Sogn silty clay loam, 0 to 3 percent slopes	VIIs	No	Shallow Limy.
St	Steedman stony loam, 5 to 20 percent slopes	VIe	No	Loamy Upland.
Sv	Stephenville fine sandy loam, 1 to 4 percent slopes	IIe	Yes	Savannah.
Sw	Stephenville-Darnell fine sandy loams, 1 to 6 percent slopes	VIe	No	
	Stephenville			Savannah.
	Darnell			Shallow Savannah.
Vd	Verdigris silt loam, channeled	Vw	No	Loamy Lowland.
Vf	Verdigris silt loam, occasionally flooded	IIw	Yes	Loamy Lowland.
Wo	Woodson silt loam, 0 to 2 percent slopes	IIs	Yes**	Clay Upland.

* A soil complex is treated as a single management unit in the land capability classification and prime farmland columns.

** Where drained.

NRCS Accessibility Statement



SOIL LEGEND

1 — NIOTAZE-DARNELL-STEPHENVILLE association: Moderately deep and shallow, gently sloping to steep, somewhat poorly drained and well drained soils that have a clayey or loamy subsoil; on uplands

2 — STEEDMAN-DENNIS-ERAM association: Moderately deep and deep, gently sloping to strongly sloping, moderately well drained soils that have a dominantly clayey subsoil; on uplands

3 — FLORENCE-MARTIN association: Deep, gently sloping to strongly sloping, well drained and moderately well drained soils that have a dominantly clayey or cherty clay subsoil; on uplands

4 — MASON-VERDIGRIS-LANTON association: Deep, nearly level, well drained and somewhat poorly drained soils that have a silty subsoil; on stream terraces and flood plains

5 — CLIME-SOGN-LABETTE association: Moderately deep and shallow, nearly level to moderately steep, well drained and somewhat excessively drained soils that have a clayey or silty subsoil; on uplands

6 — ERAM-KENOMA-CATOOSA association: Moderately deep and deep, nearly level to moderately sloping, moderately well drained and well drained soils that have a clayey or silty subsoil; on uplands and high terraces

Compiled 1984

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

N

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
KANSAS AGRICULTURAL EXPERIMENT STATION

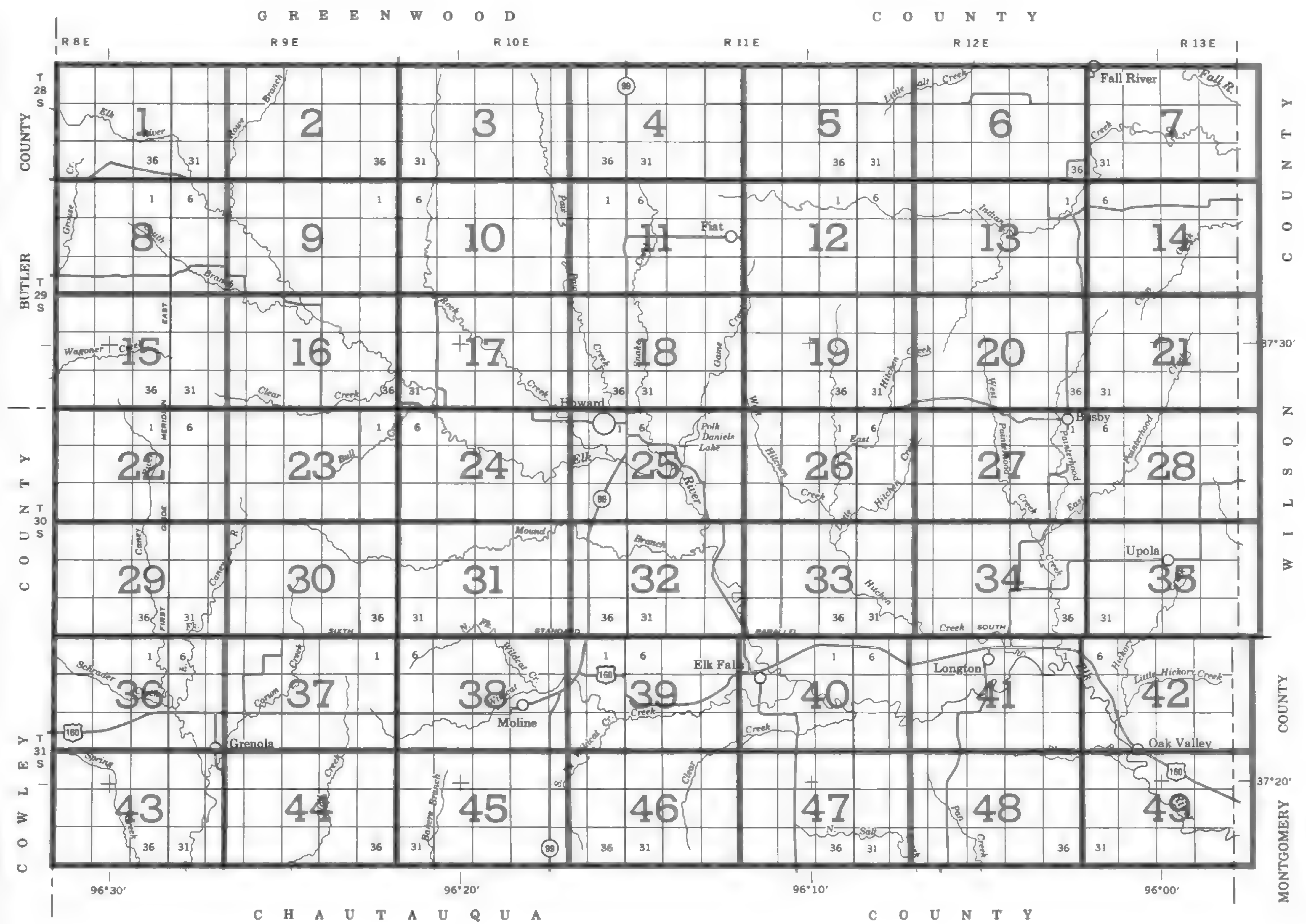
GENERAL SOIL MAP
ELK COUNTY, KANSAS

Scale 1:190,080

1 0 1 2 3 Miles

1 0 3 Km

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS
ELK COUNTY, KANSAS

Scale 1:190,080

SOIL LEGEND

SYMBOL	NAME
Ba	Bates fine sandy loam, 1 to 4 percent slopes
Bb	Bates loam, 4 to 7 percent slopes
Bf	Benfield cherty silt loam, 4 to 10 percent slopes
Cd	Catoosa silt loam, 0 to 2 percent slopes
Cf	Catoosa-Sogn complex, 0 to 8 percent slopes
Ck	Clime stony silty clay loam, 20 to 30 percent slopes
Cm	Clime silty clay, 3 to 7 percent slopes
Cs	Clime-Sogn complex, 5 to 20 percent slopes
Cv	Collinsville-Bates fine sandy loams, 2 to 8 percent slopes
De	Dennis silt loam, 1 to 4 percent slopes
Df	Dennis silt loam, 4 to 7 percent slopes
Dg	Dennis silty clay loam, 3 to 7 percent slopes, eroded
Dw	Dwight silt loam, 0 to 2 percent slopes
Em	Eram silt loam, 1 to 4 percent slopes
En	Eram silty clay loam, 4 to 7 percent slopes
Eo	Eram silty clay loam, 3 to 7 percent slopes, eroded
Es	Eram-Dwight silt loams, 1 to 4 percent slopes
Fe	Fiat silty clay loam, 1 to 3 percent slopes
Fm	Florence-Martin complex, 2 to 12 percent slopes
Iv	Ivan silt loam, channeled
Iw	Ivan silt loam, occasionally flooded
Kd	Kenoma silt loam, 1 to 3 percent slopes
La	Labette silty clay loam, 1 to 4 percent slopes
Ld	Labette-Dwight complex, 0 to 3 percent slopes
Lg	Labette-Sogn silty clay loams, 0 to 8 percent slopes
Ln	Lanton silty clay loam, occasionally flooded
Mb	Martin silty clay loam, 1 to 4 percent slopes
Mc	Martin silty clay loam, 4 to 7 percent slopes
Me	Martin silty clay, 3 to 7 percent slopes, eroded
Mn	Mason silt loam
Nc	Newtonia silt loam, 1 to 3 percent slopes
Nd	Niotaze-Darnell complex, 6 to 35 percent slopes
Os	Osage silty clay loam, occasionally flooded
Po	Pits, quarries
Pr	Prue fine sandy loam, 2 to 6 percent slopes
Sh	Sogn silty clay loam, 0 to 3 percent slopes
St	Steedman stony loam, 5 to 20 percent slopes
Sv	Stephenville fine sandy loam, 1 to 4 percent slopes
Sw	Stephenville-Darnell fine sandy loams, 1 to 6 percent slopes
Vd	Verdigris silt loam, channeled
Vf	Verdigris silt loam, occasionally flooded
Wo	Woodson silt loam, 0 to 2 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label) — Hedley Airstrip

- Small airport, airfield, park, oilfield, cemetery, or flood pool — FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate — 21
- Federal — 173
- State — 28
- County, farm or ranch — 1283

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small — water — w

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — Gas
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water — w
- Intermittent — int — i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — La — Nd

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

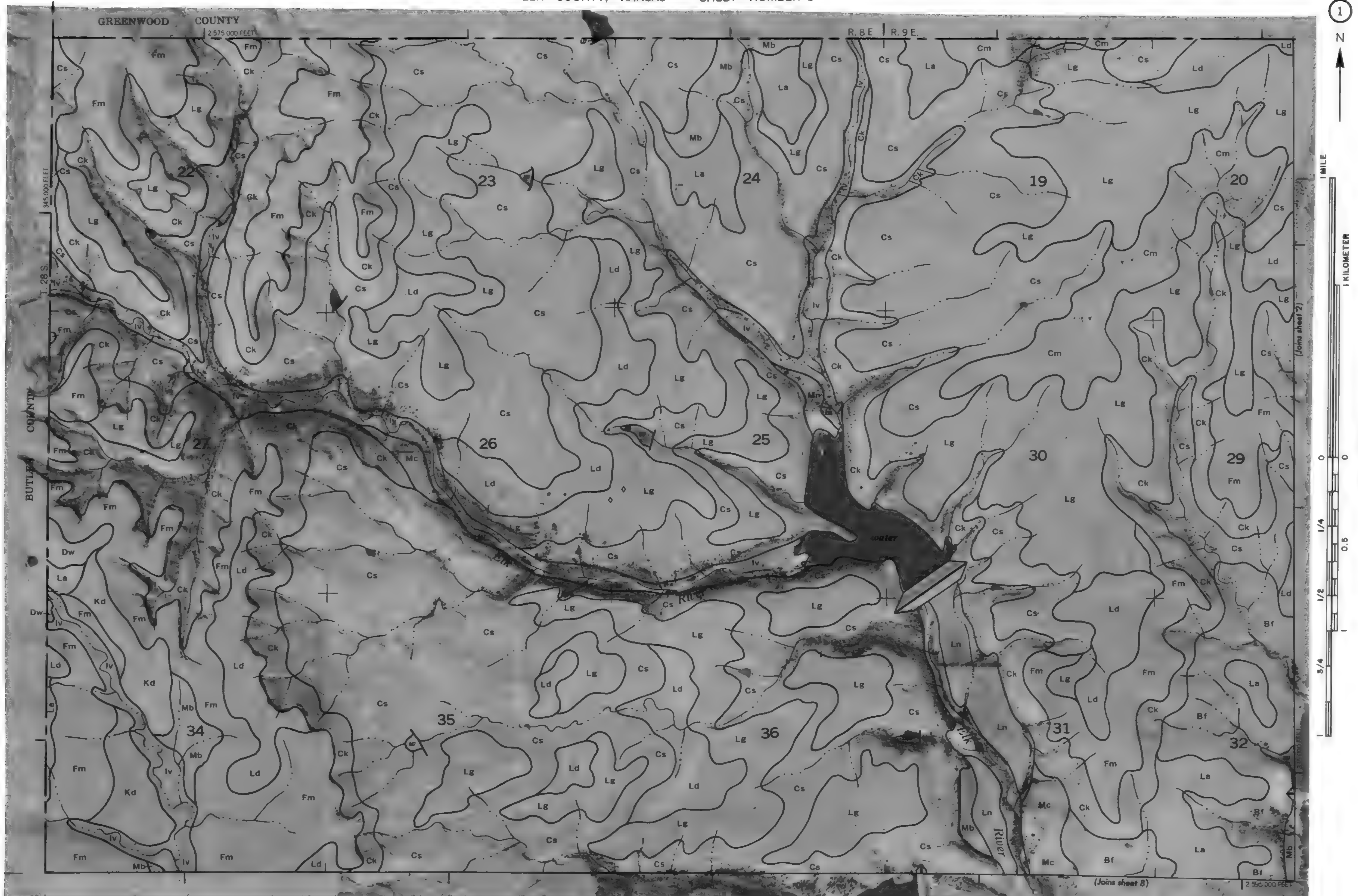
DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown) — S

MISCELLANEOUS

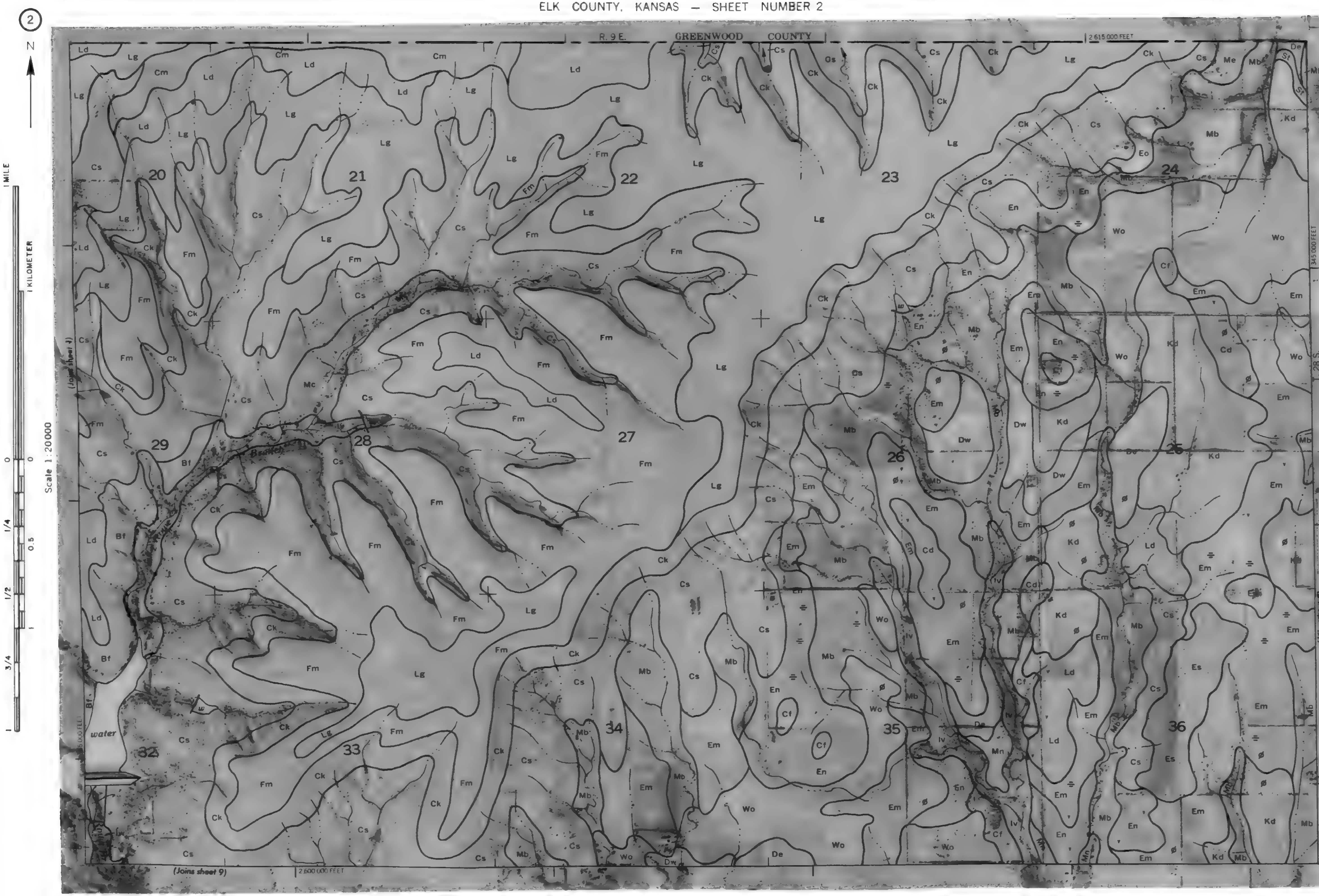
- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

ELK COUNTY, KANSAS — SHEET NUMBER 1



ELK COUNTY, KANSAS NO. 1

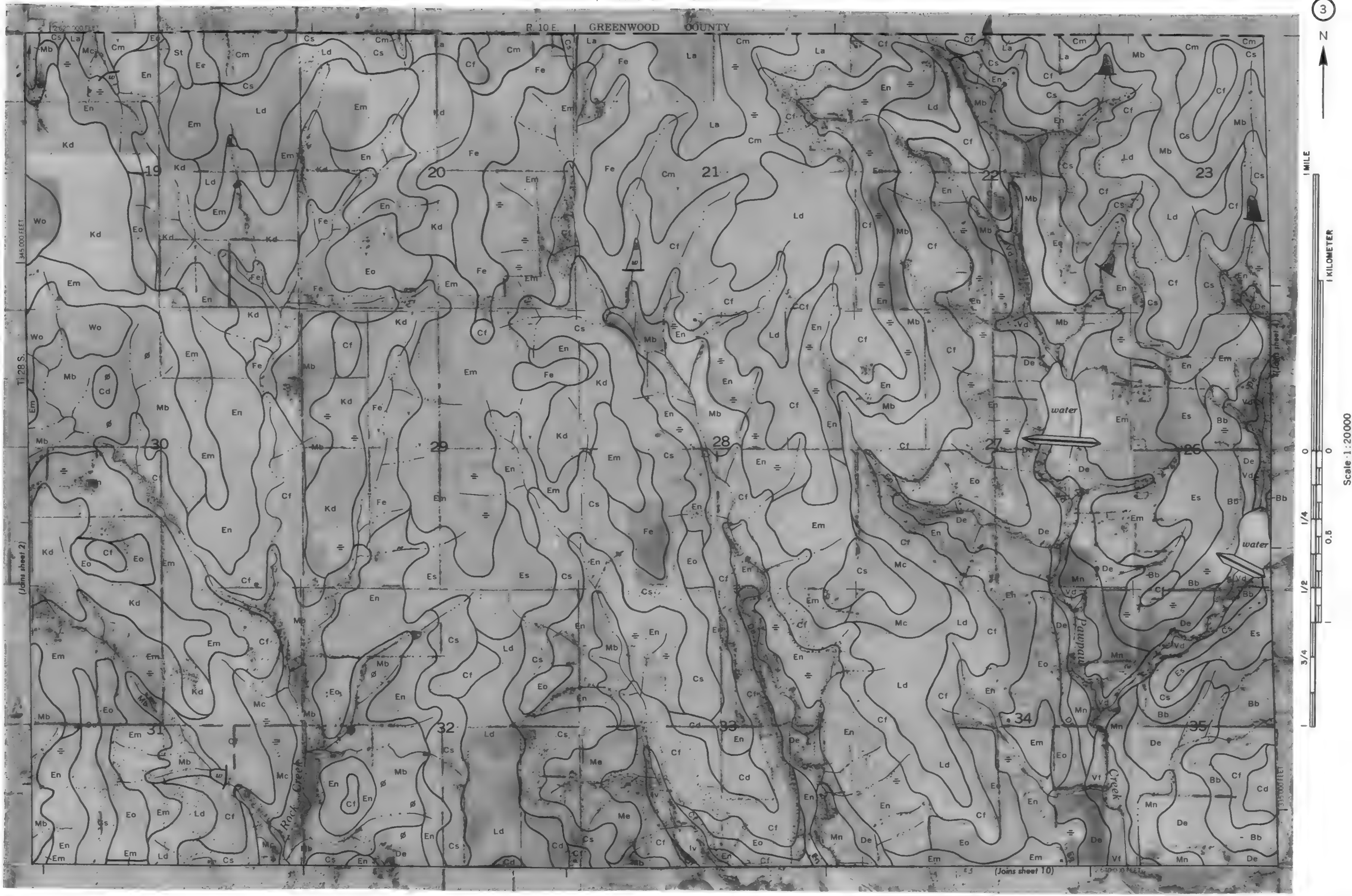
This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on [illegible] aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ELK COUNTY, KANSAS NO. 2

ELK COUNTY, KANSAS — SHEET NUMBER 3

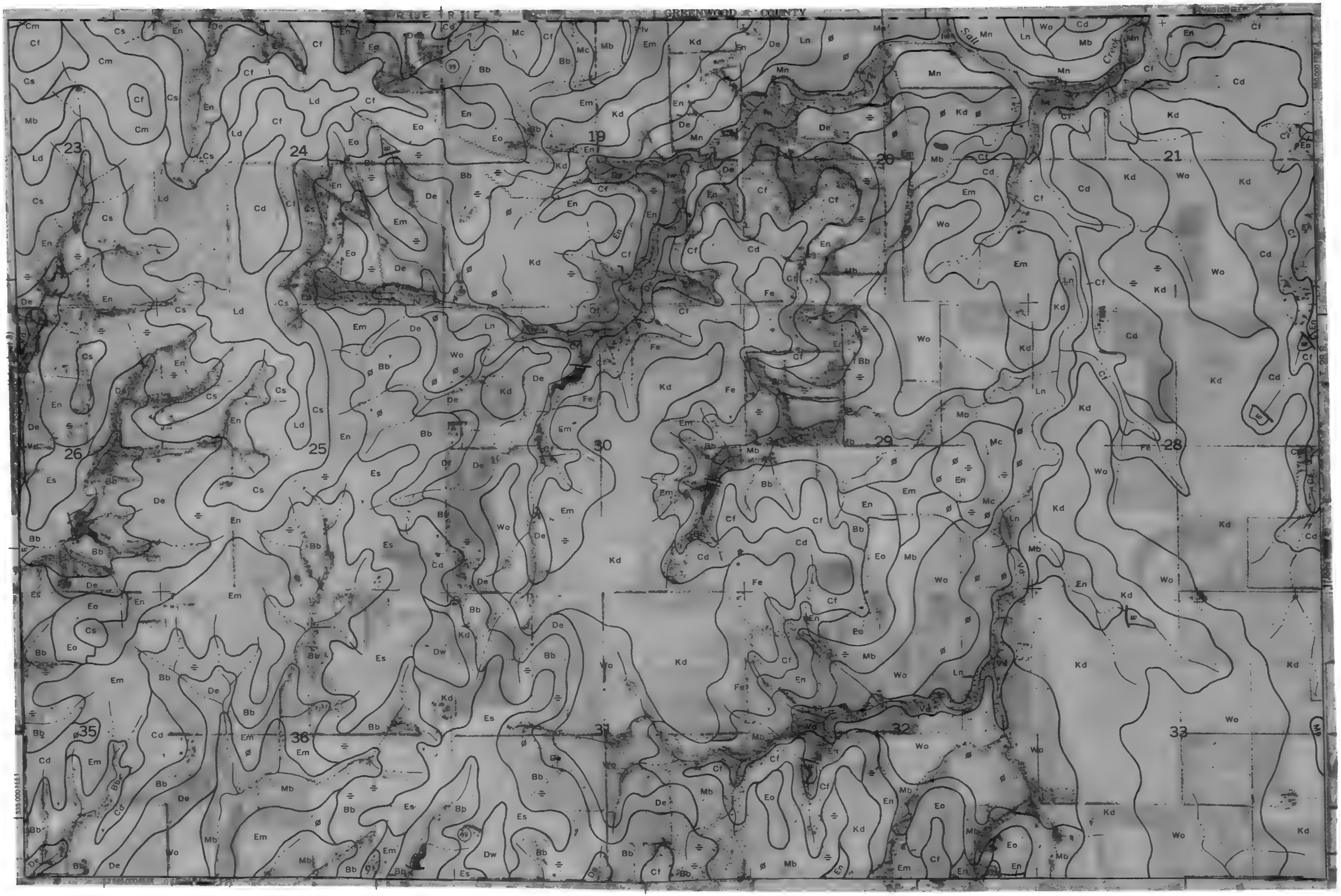


ELK COUNTY, KANSAS NO. 3

This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

4

N



1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
1
Scale 1:20000

This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
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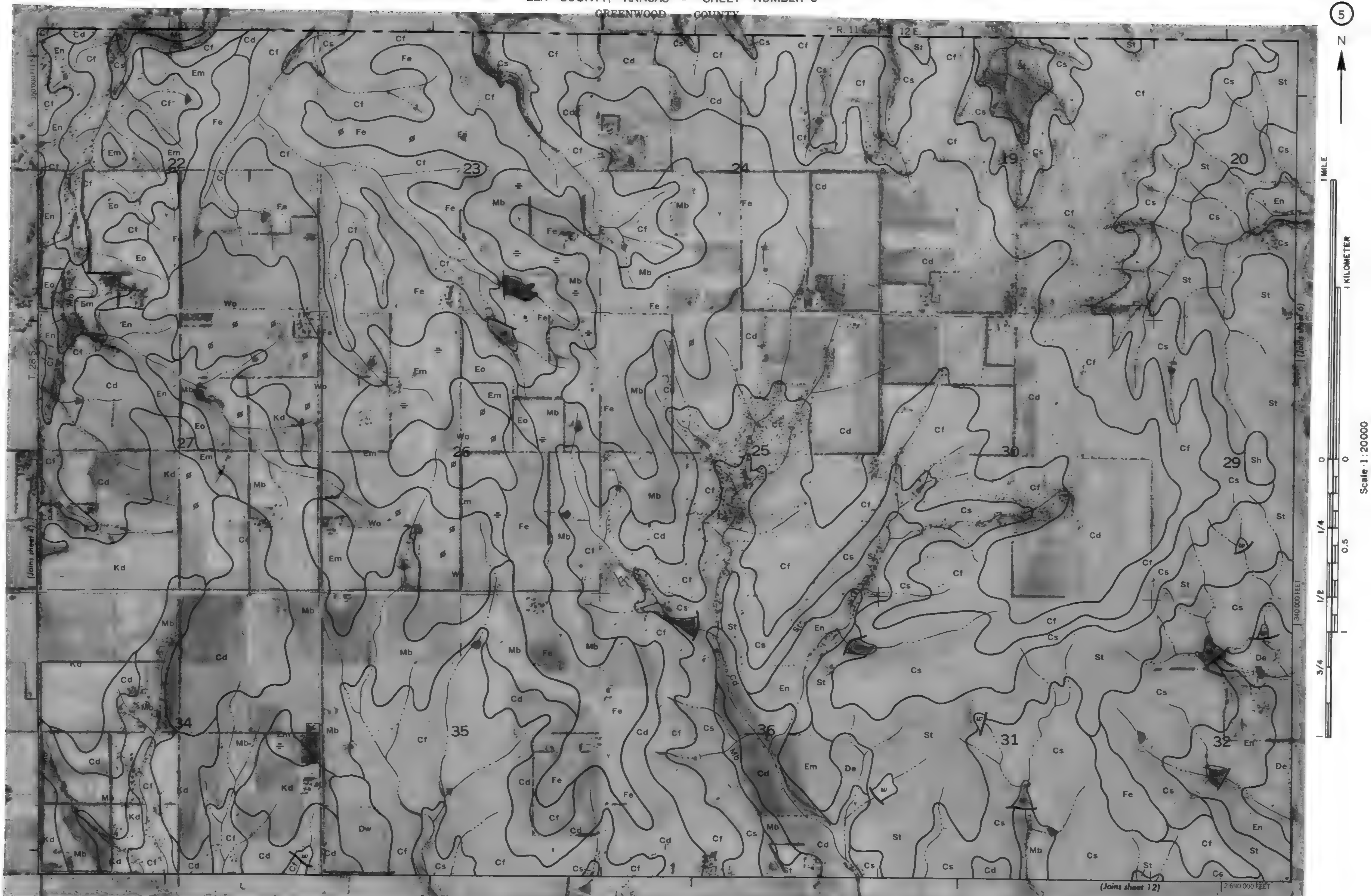
ELK COUNTY, KANSAS NO. 4

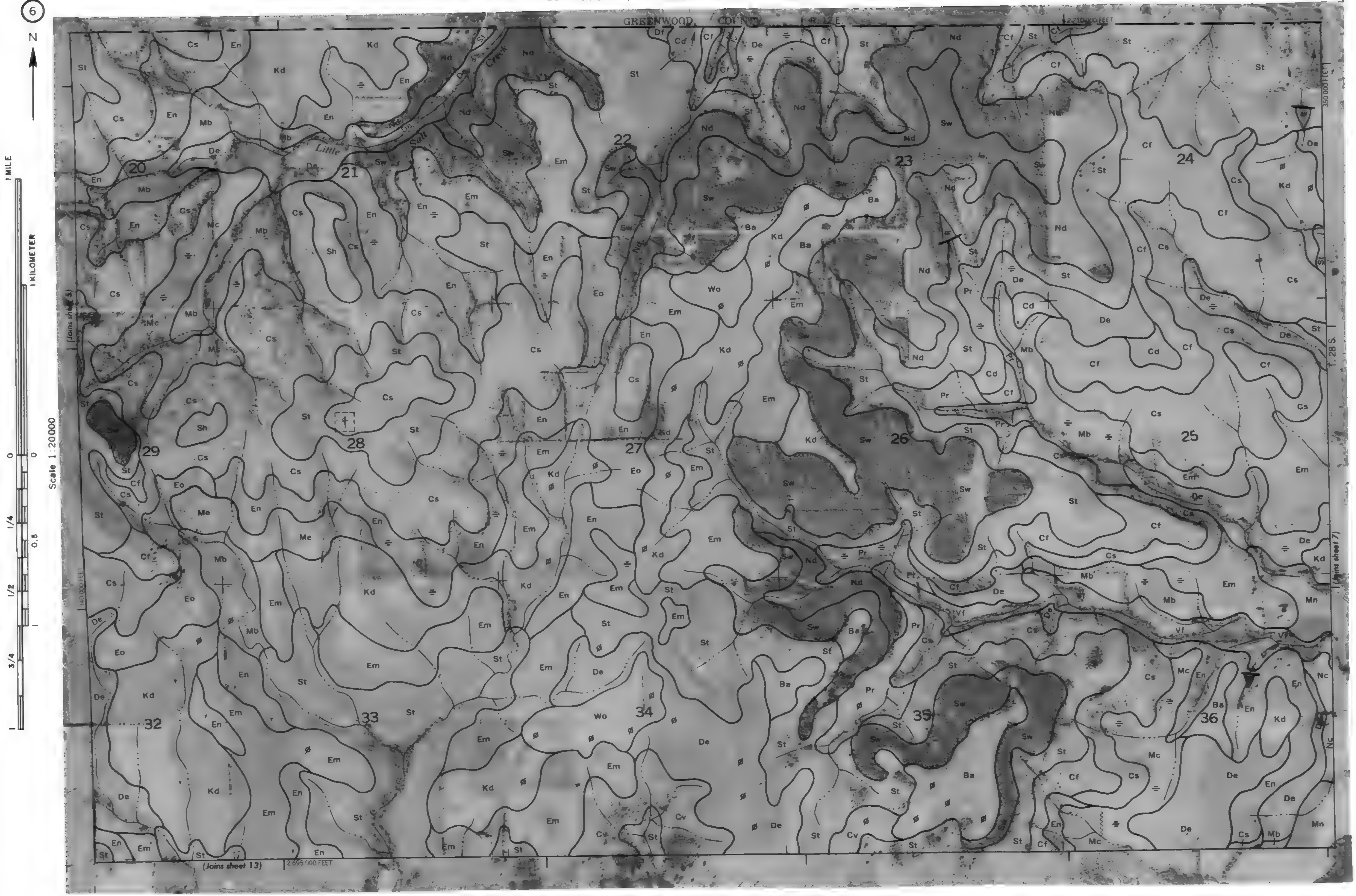
ELK COUNTY, KANSAS — SHEET NUMBER 5



ELK COUNTY, KANSAS NO. 5

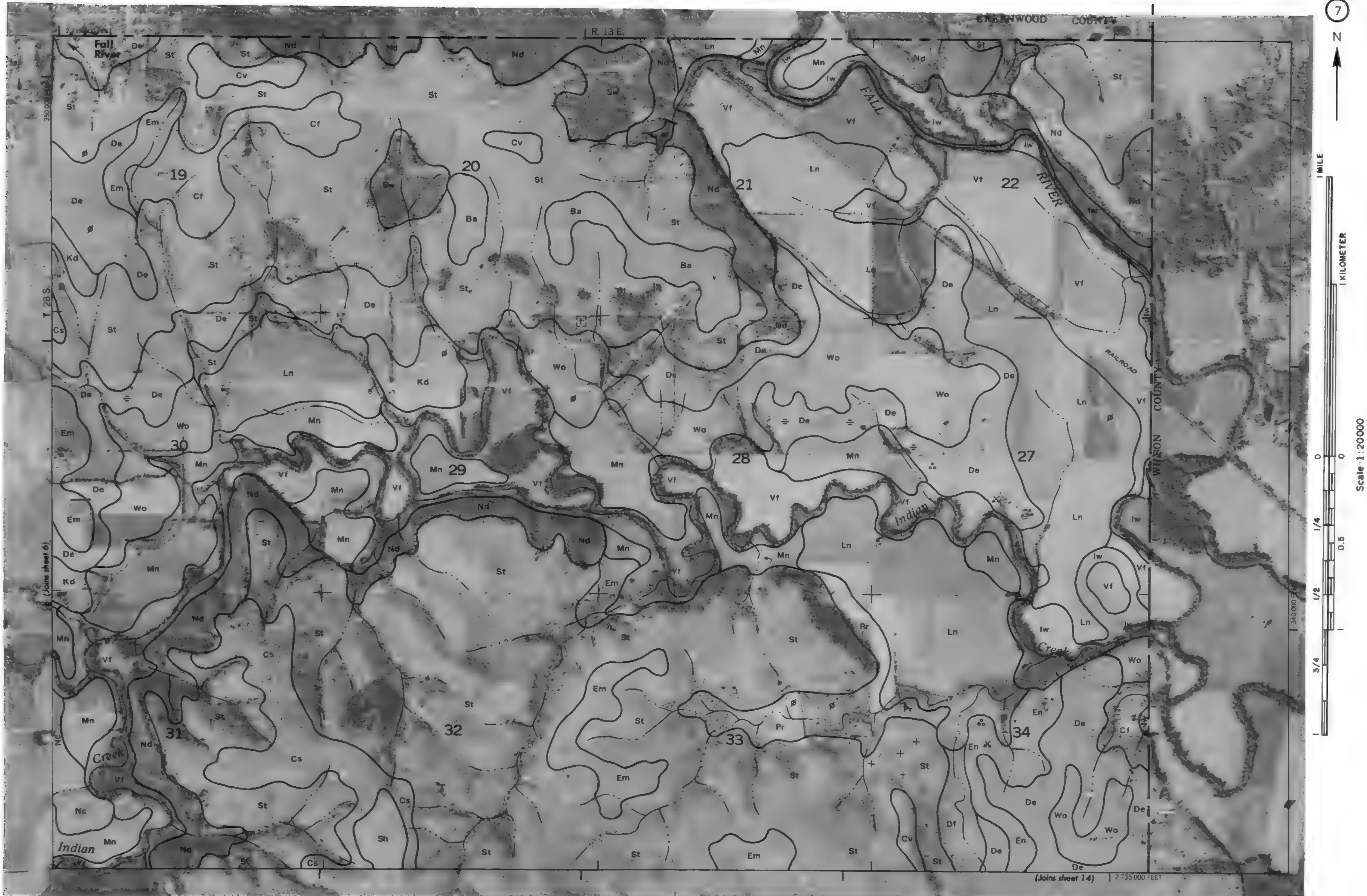
This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ELK COUNTY, KANSAS — SHEET NUMBER 6



This map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ELK COUNTY, KANSAS NO. 6



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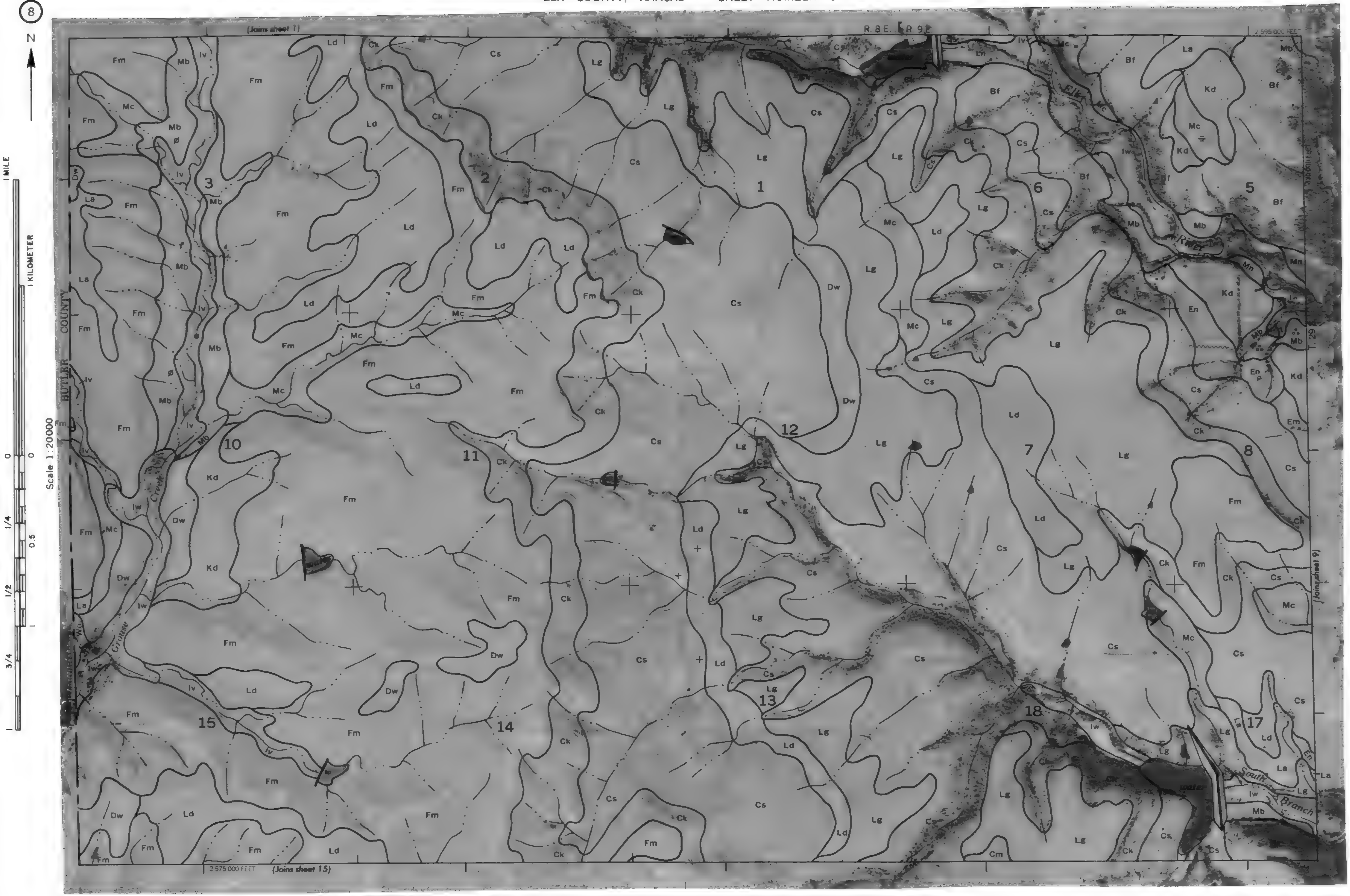
This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
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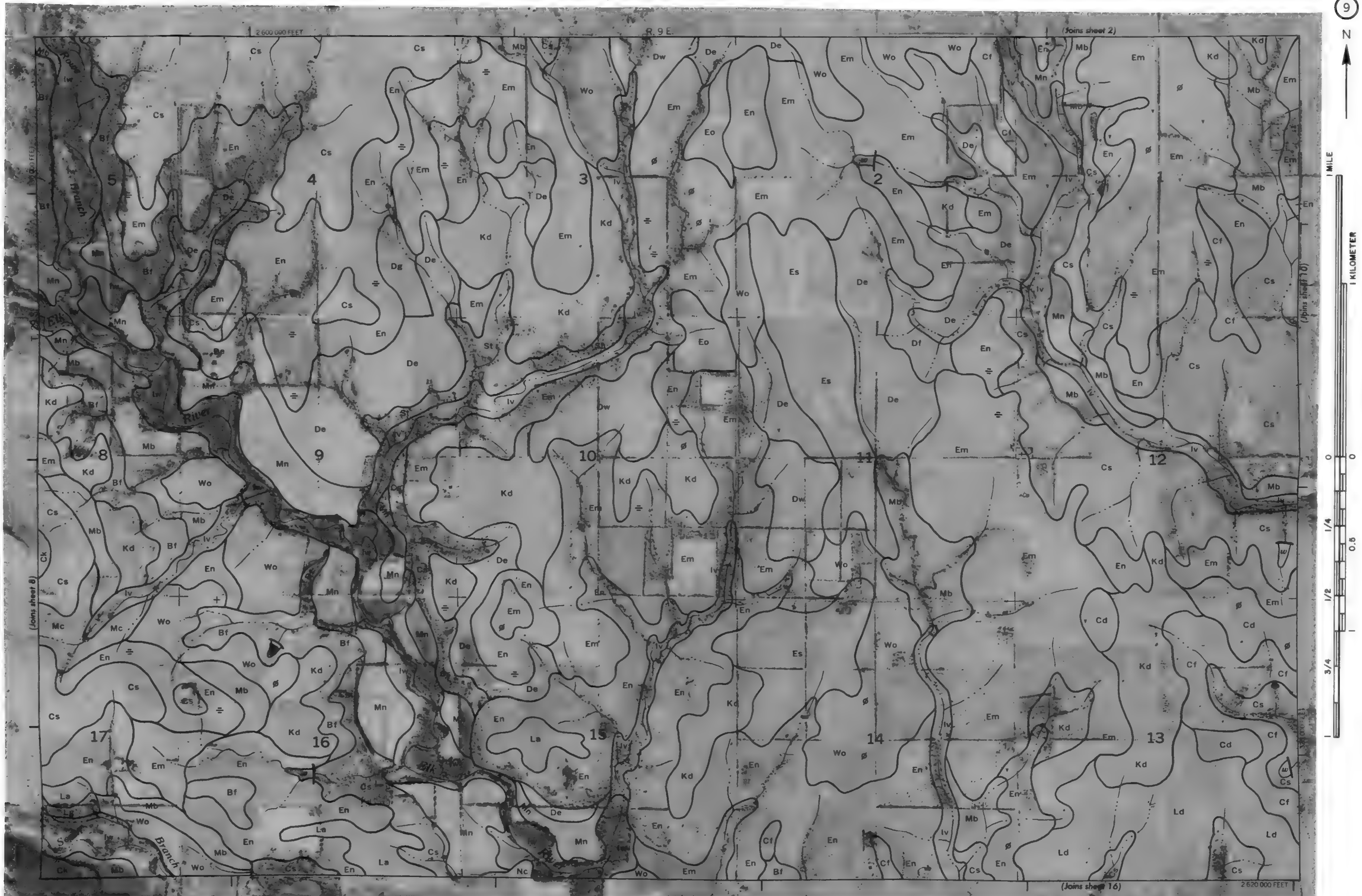
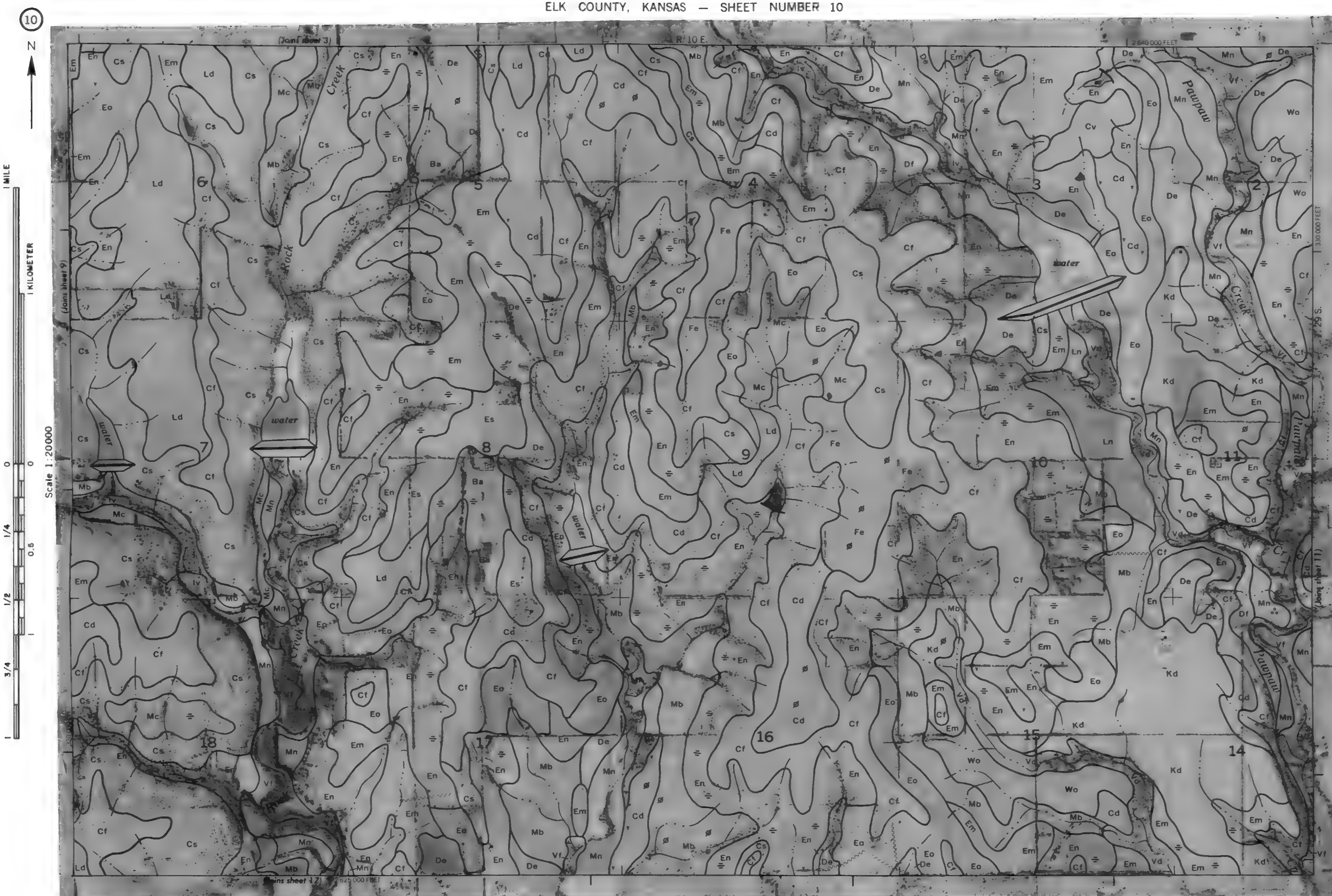
ELK COUNTY, KANSAS NO. 8

ELK COUNTY, KANSAS NO. 9

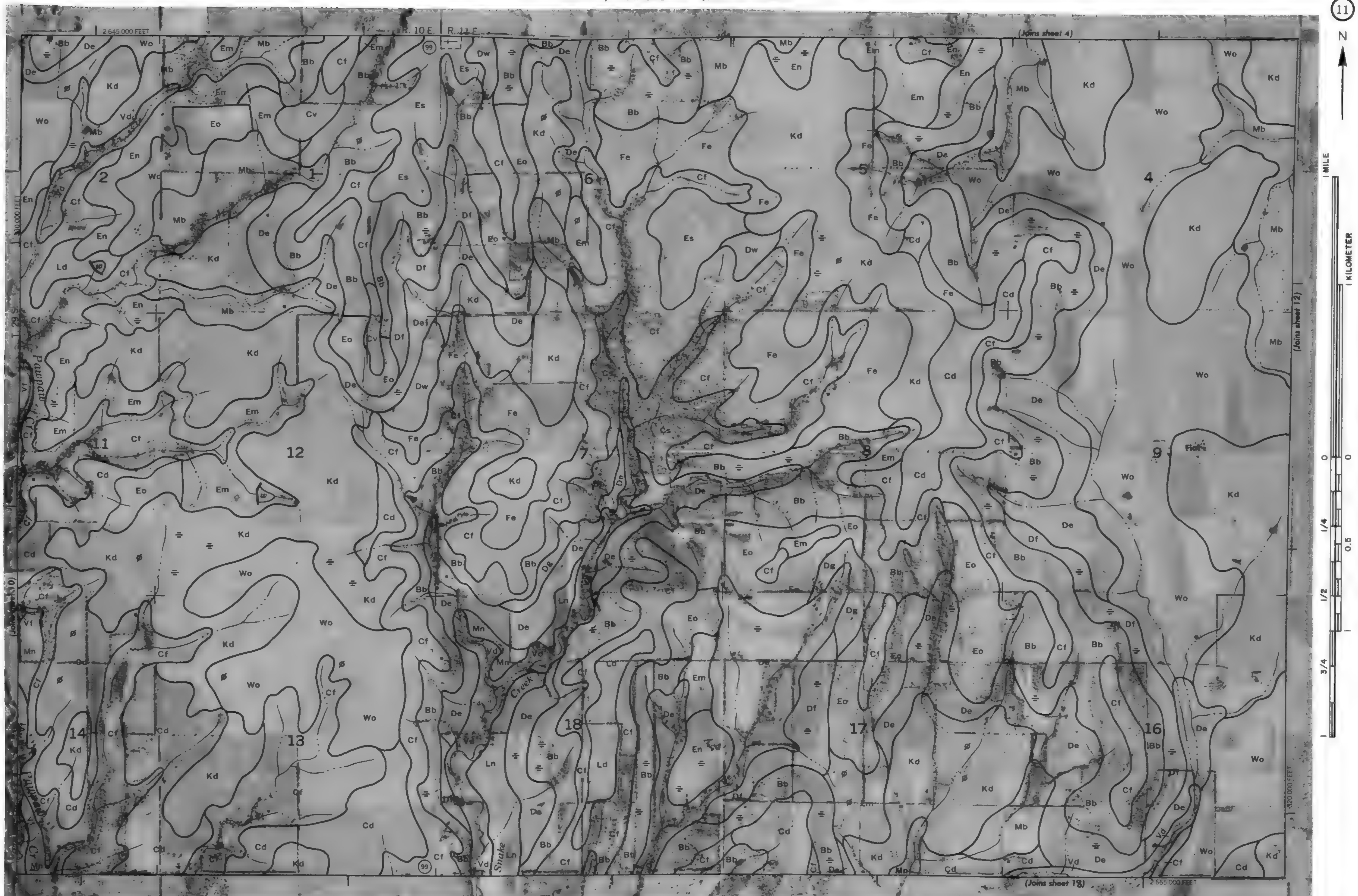
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





This map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ELK COUNTY, KANSAS NO. 10



ELK COUNTY, KANSAS NO. 11

This map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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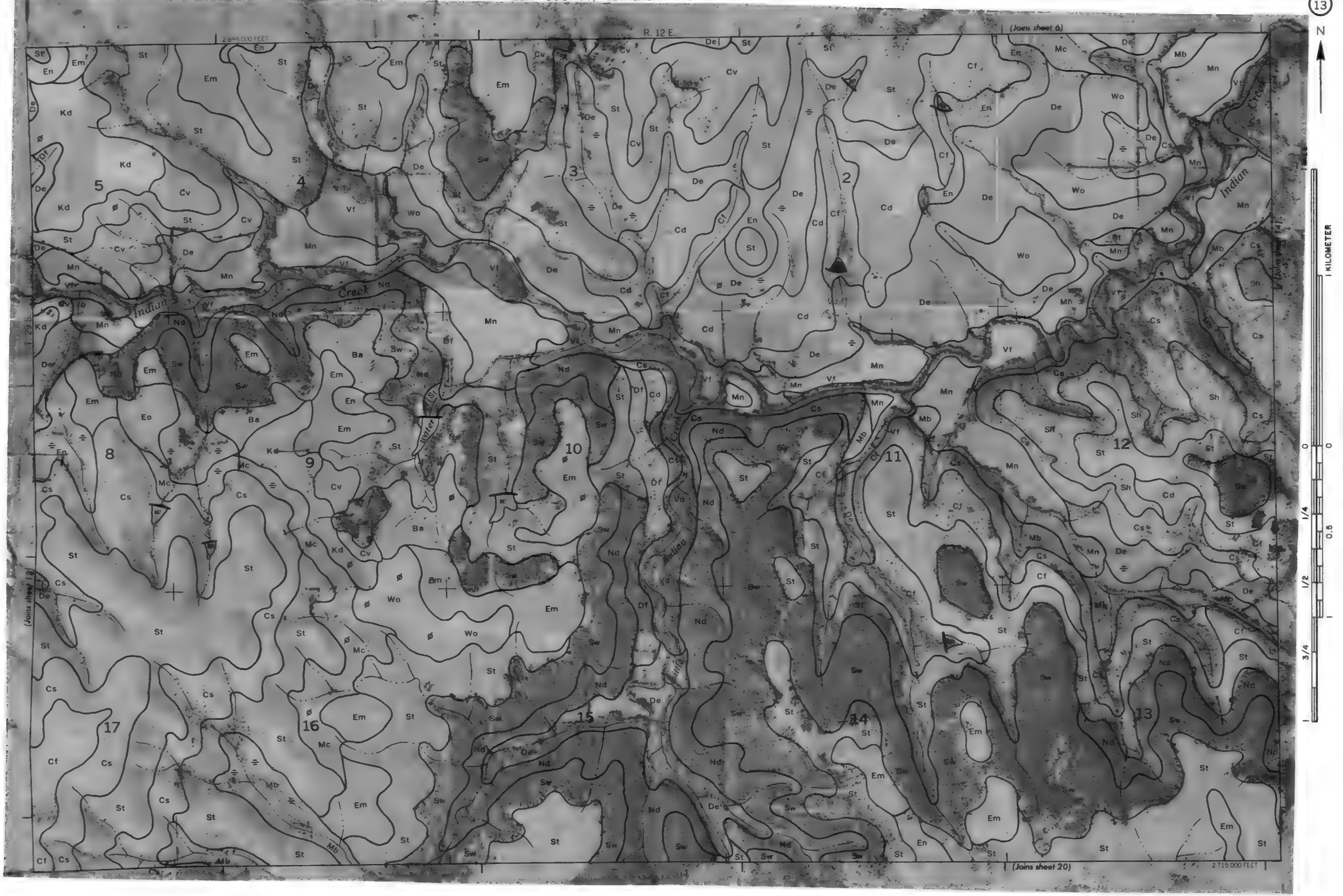
ELK COUNTY, KANSAS NO. 12

ELK COUNTY, KANSAS — SHEET NUMBER 13



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This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
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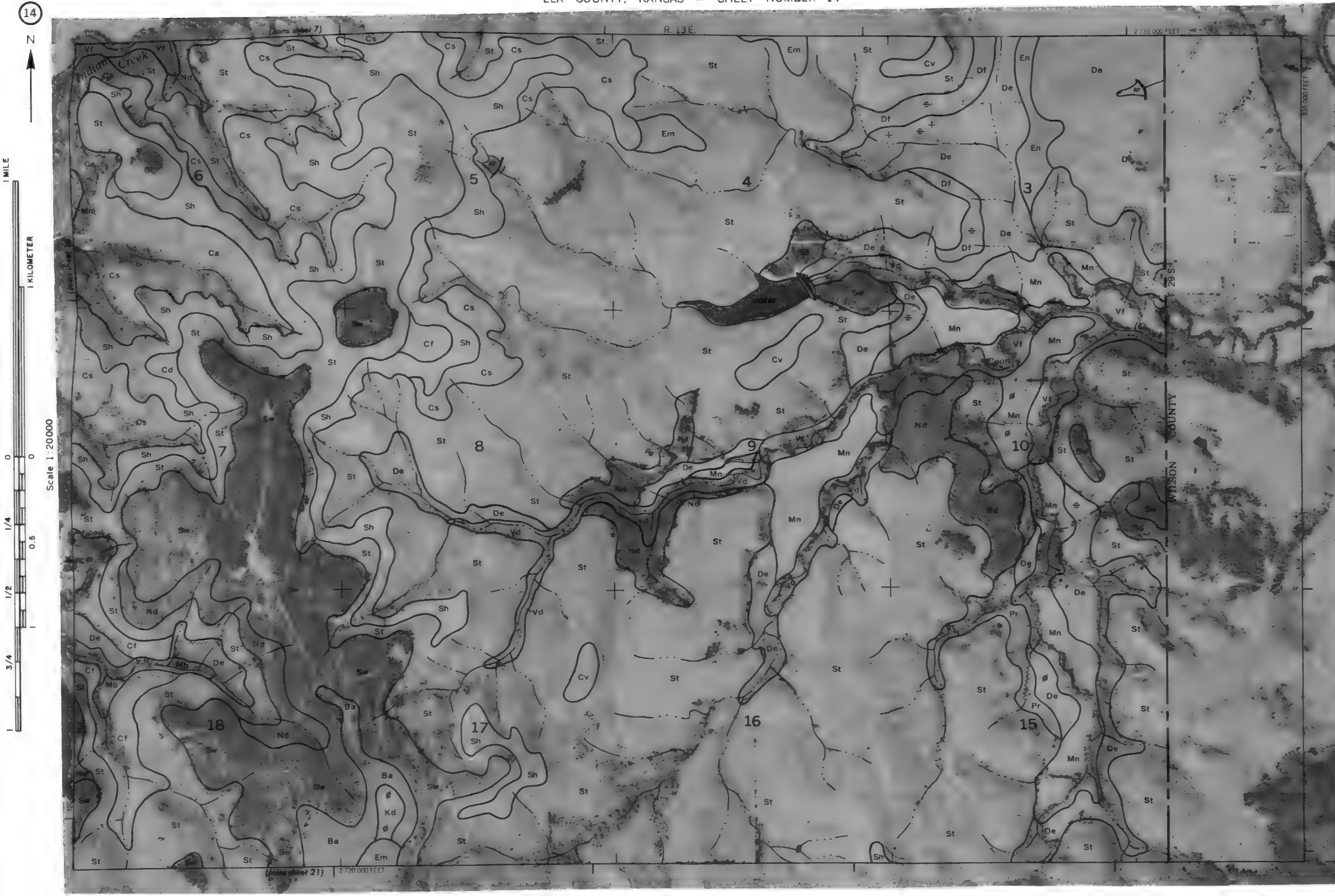

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ELK COUNTY, KANSAS NO. 14

ELK COUNTY, KANSAS NO. 15

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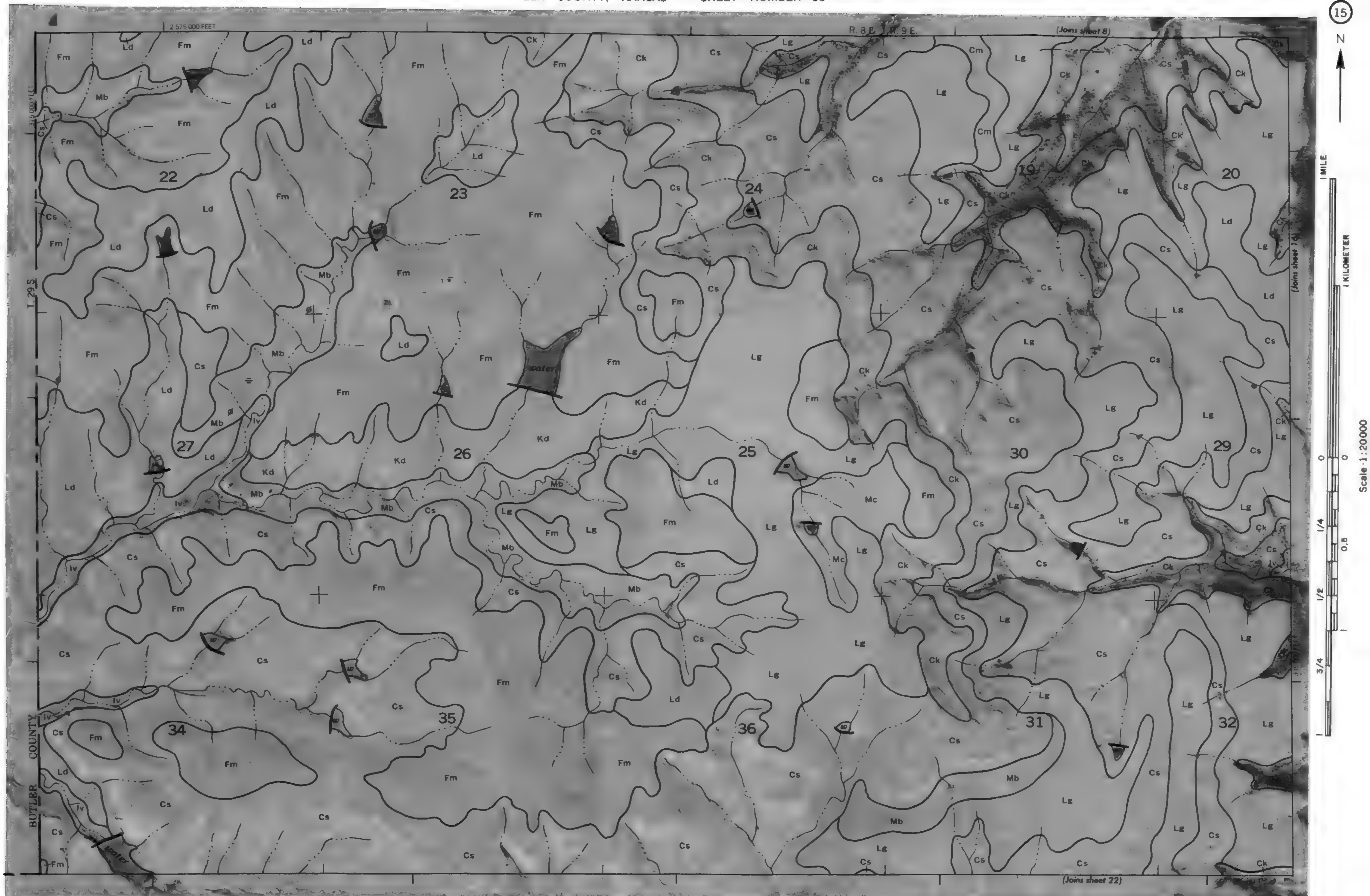
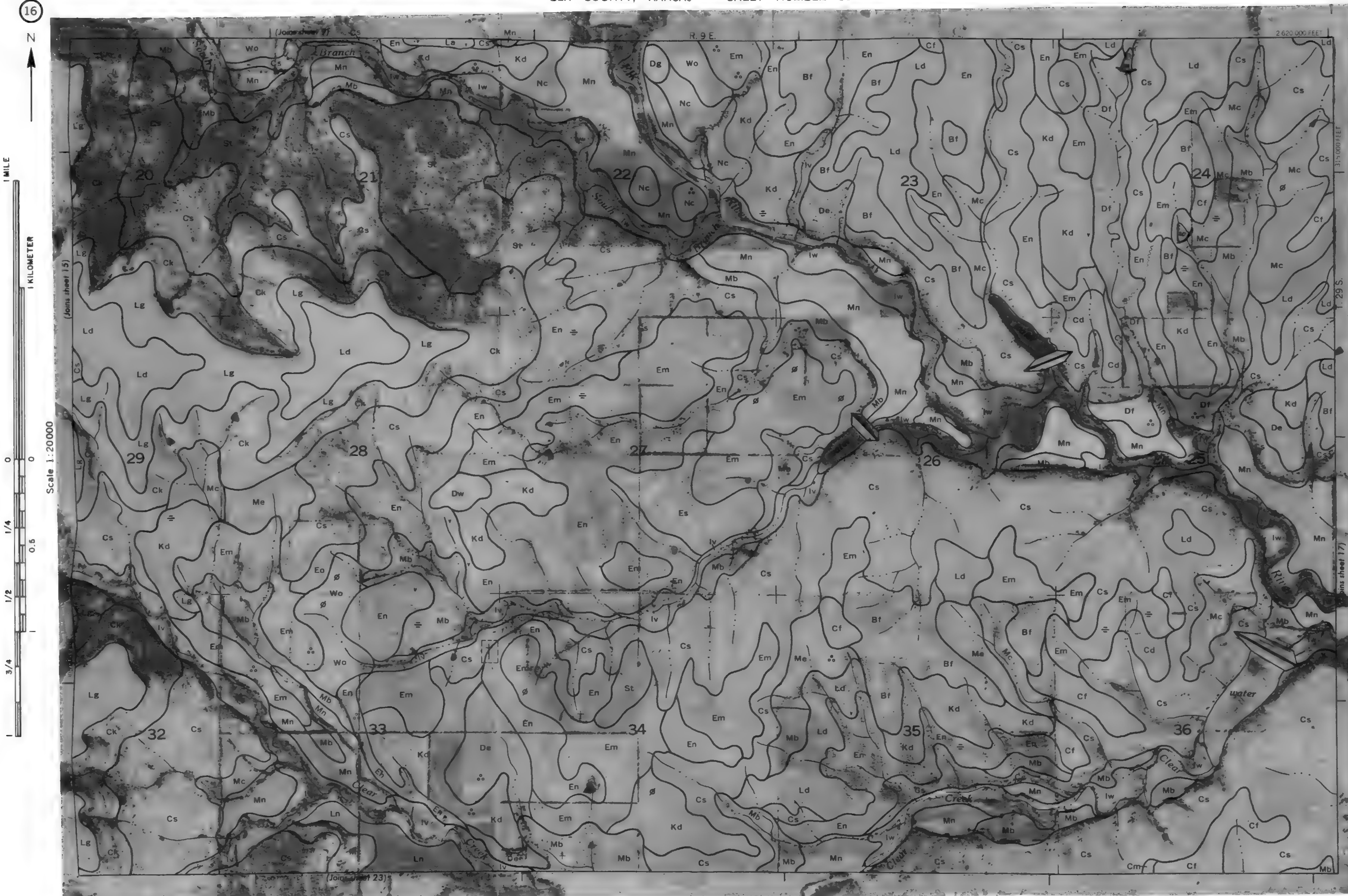


ELK COUNTY, KANSAS — SHEET NUMBER 16



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ELK COUNTY, KANSAS NO. 16

ELK COUNTY, KANSAS NO. 17

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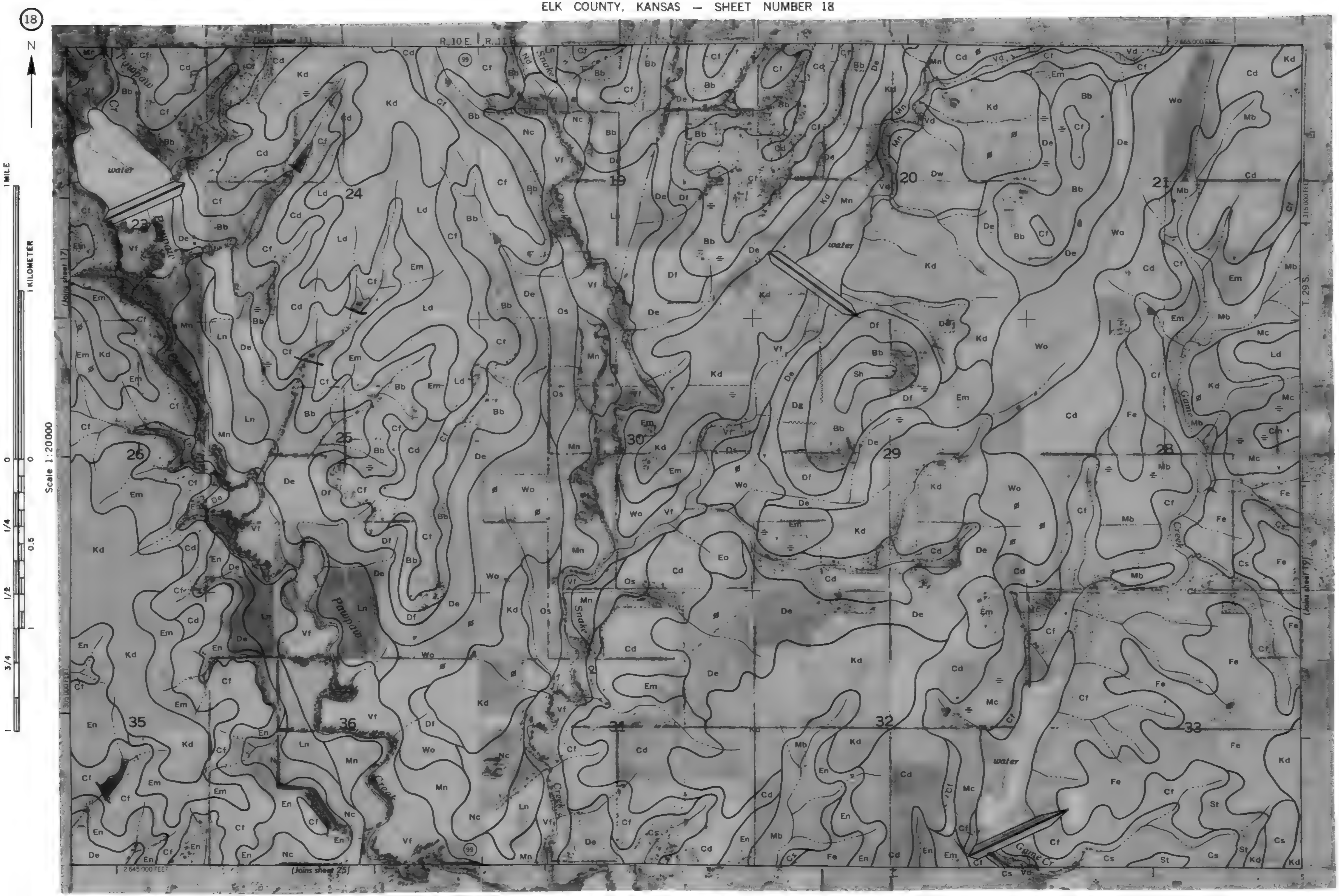

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ELK COUNTY, KANSAS NO. 18

N

1 MILE

1 KILOMETER

Scale 1:20000

ELK COUNTY, KANSAS NO. 19

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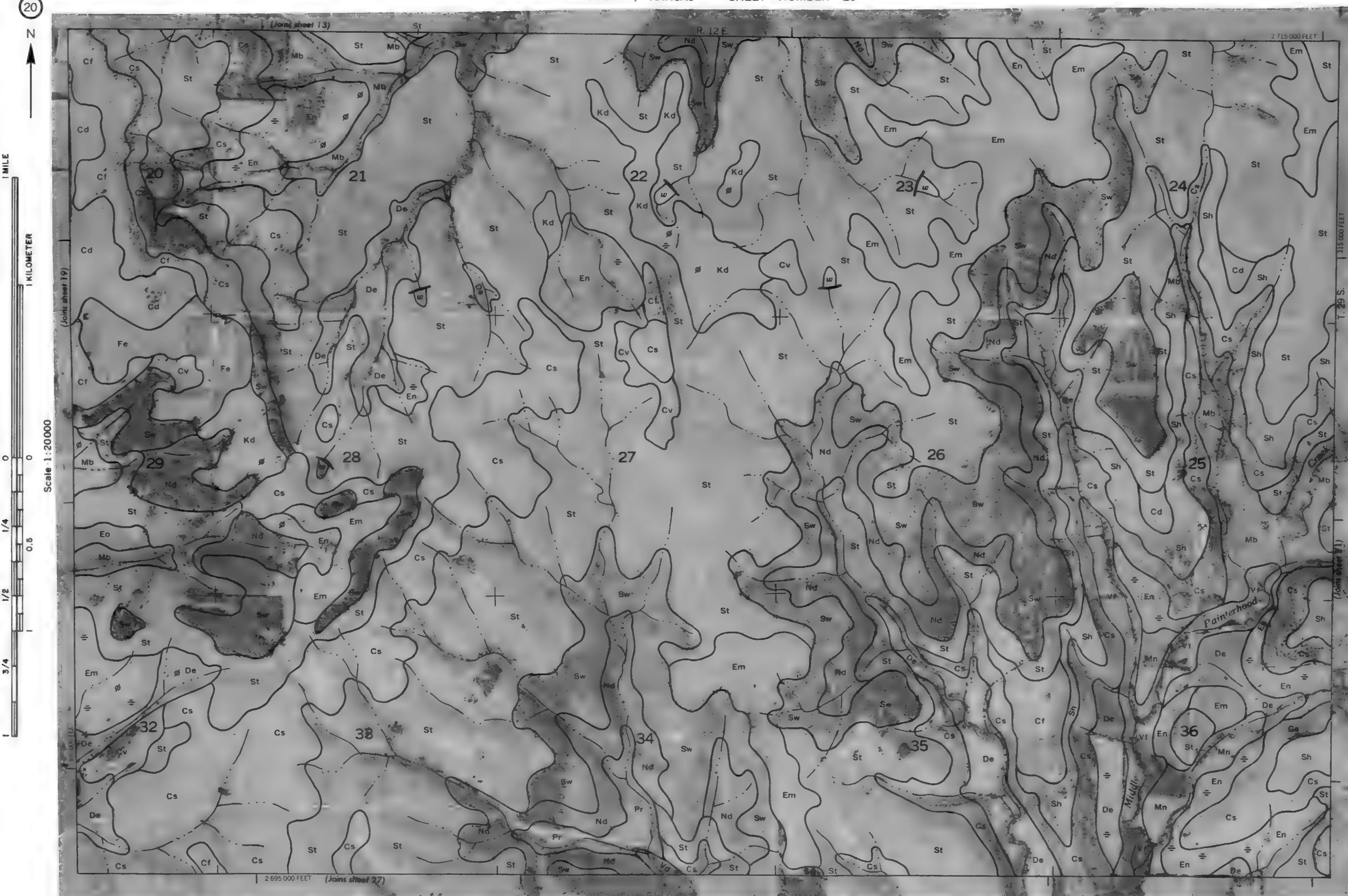

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ELK COUNTY, KANSAS NO. 20

ELK COUNTY, KANSAS NO. 21

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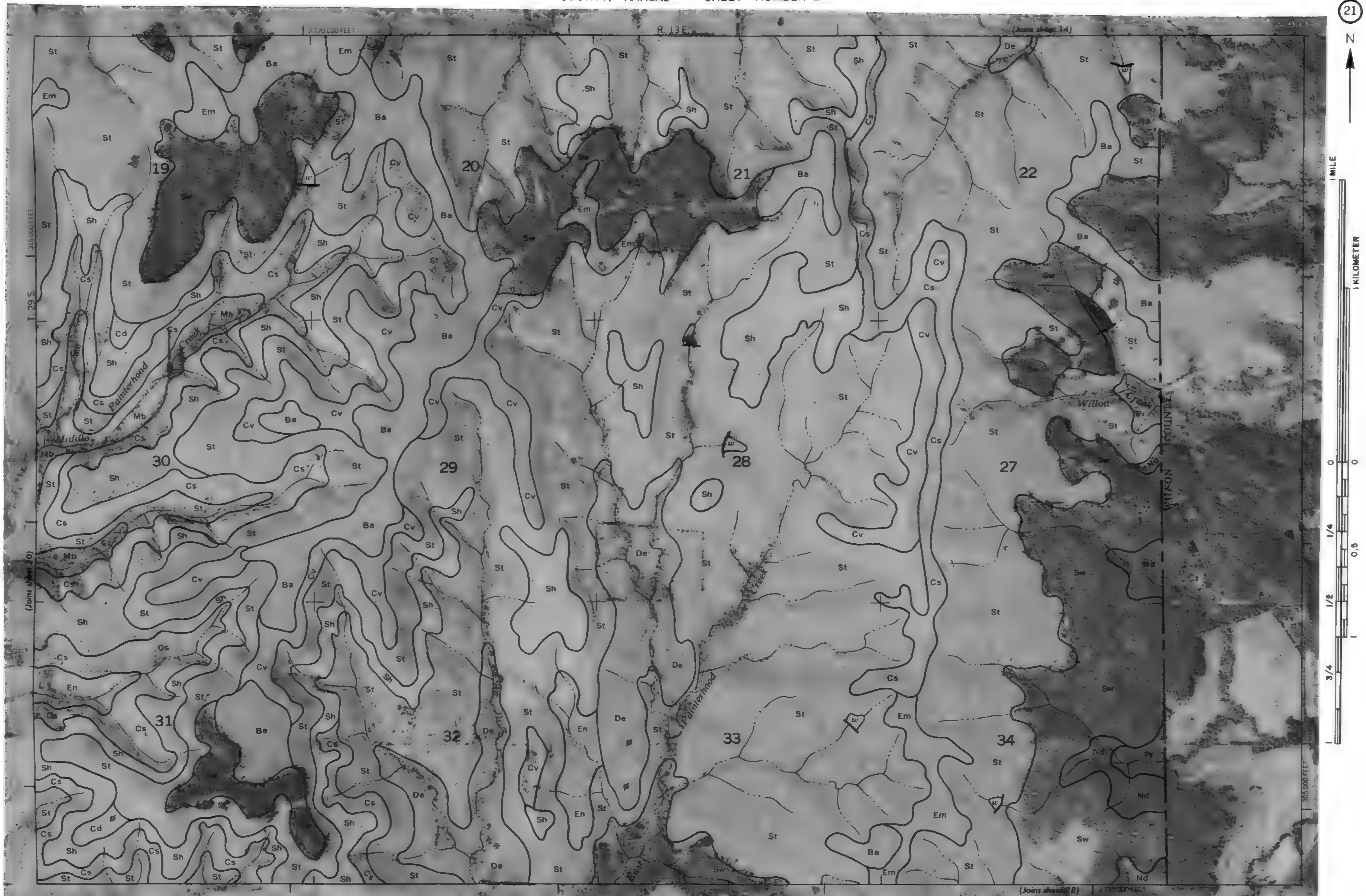

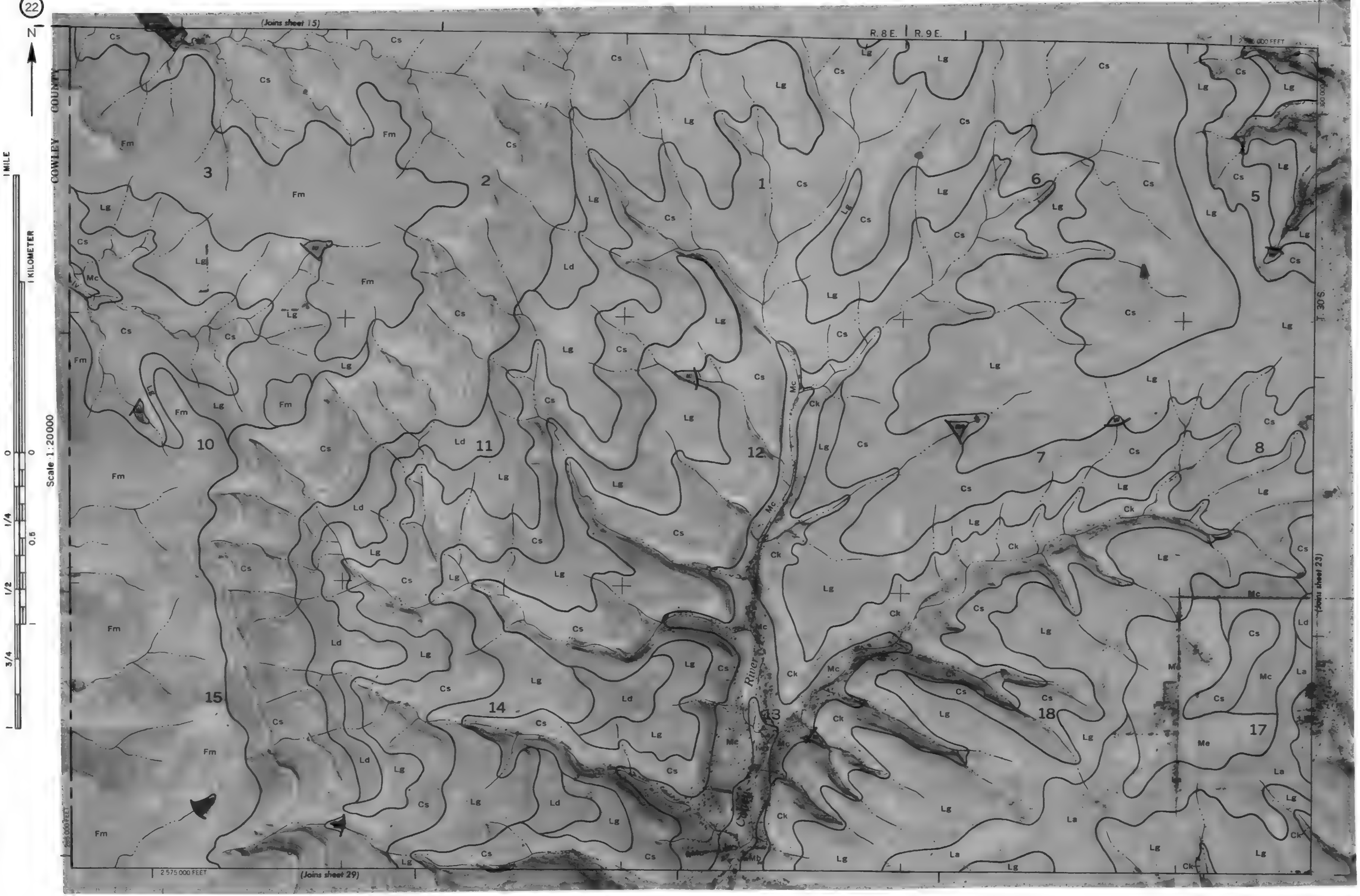

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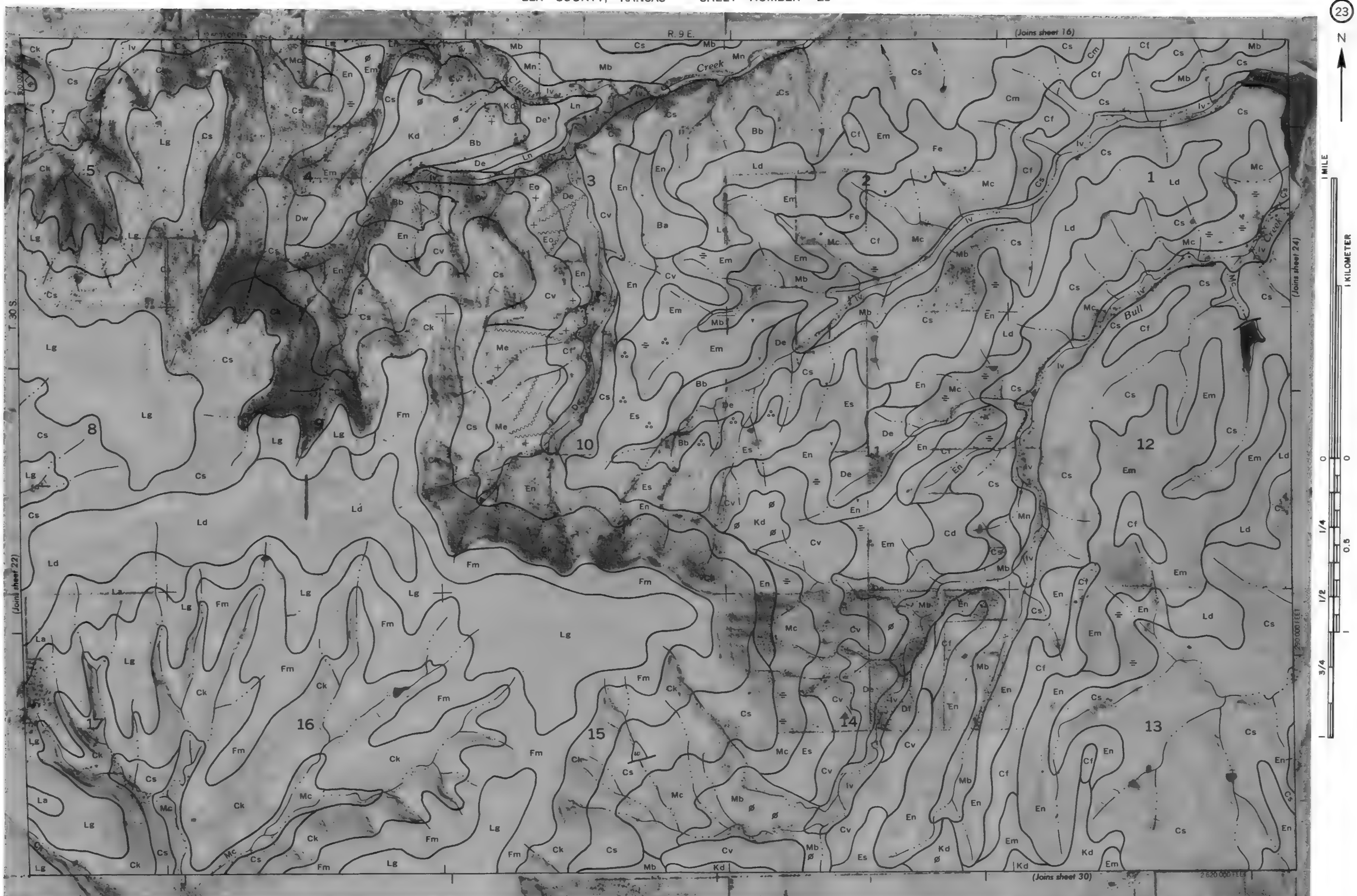
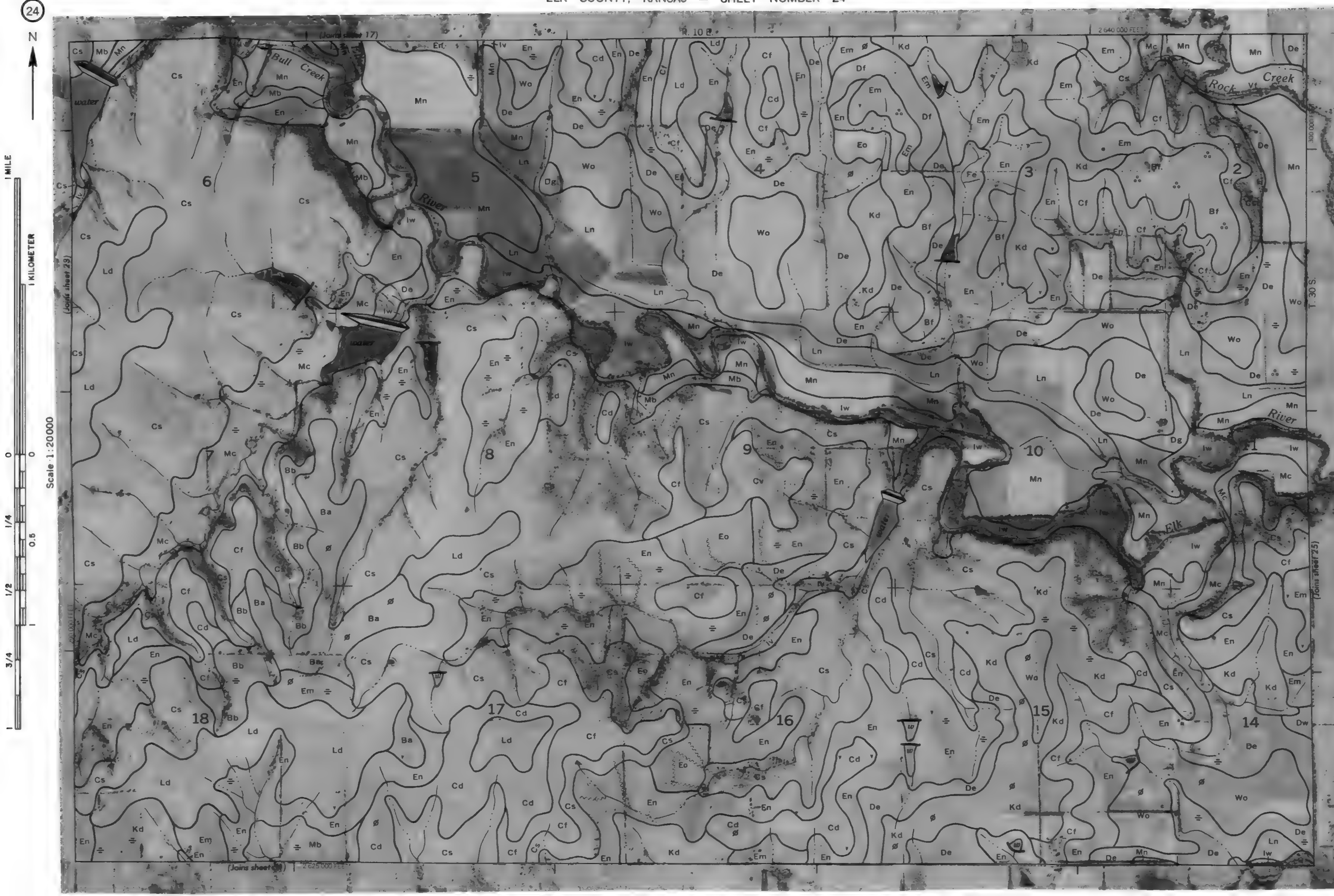


ELK COUNTY, KANSAS NO. 23

This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



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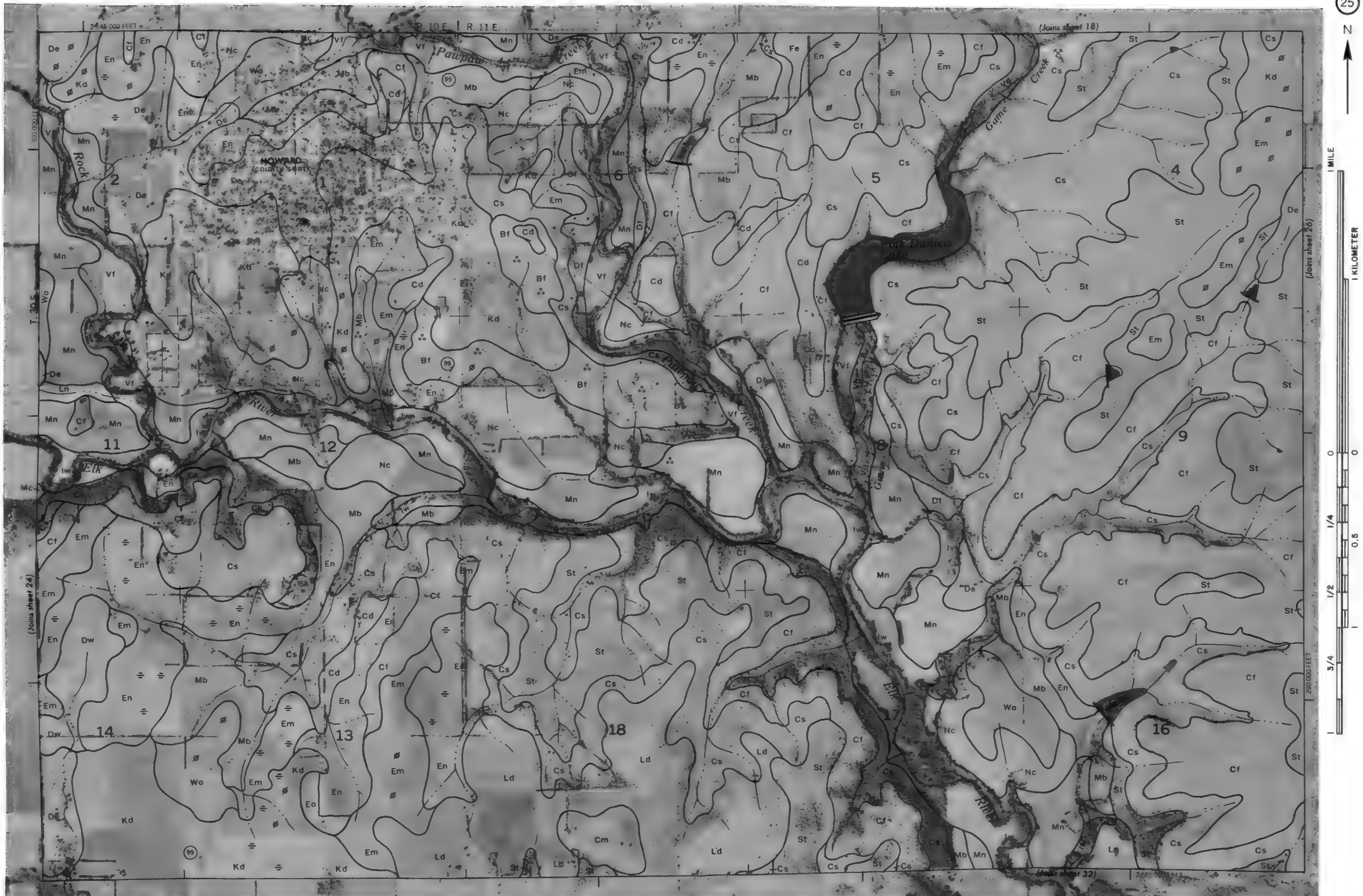
ELK COUNTY, KANSAS NO. 24



ELK COUNTY, KANSAS NO. 25

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ELK COUNTY, KANSAS NO. 26

ELK COUNTY, KANSAS NO. 27

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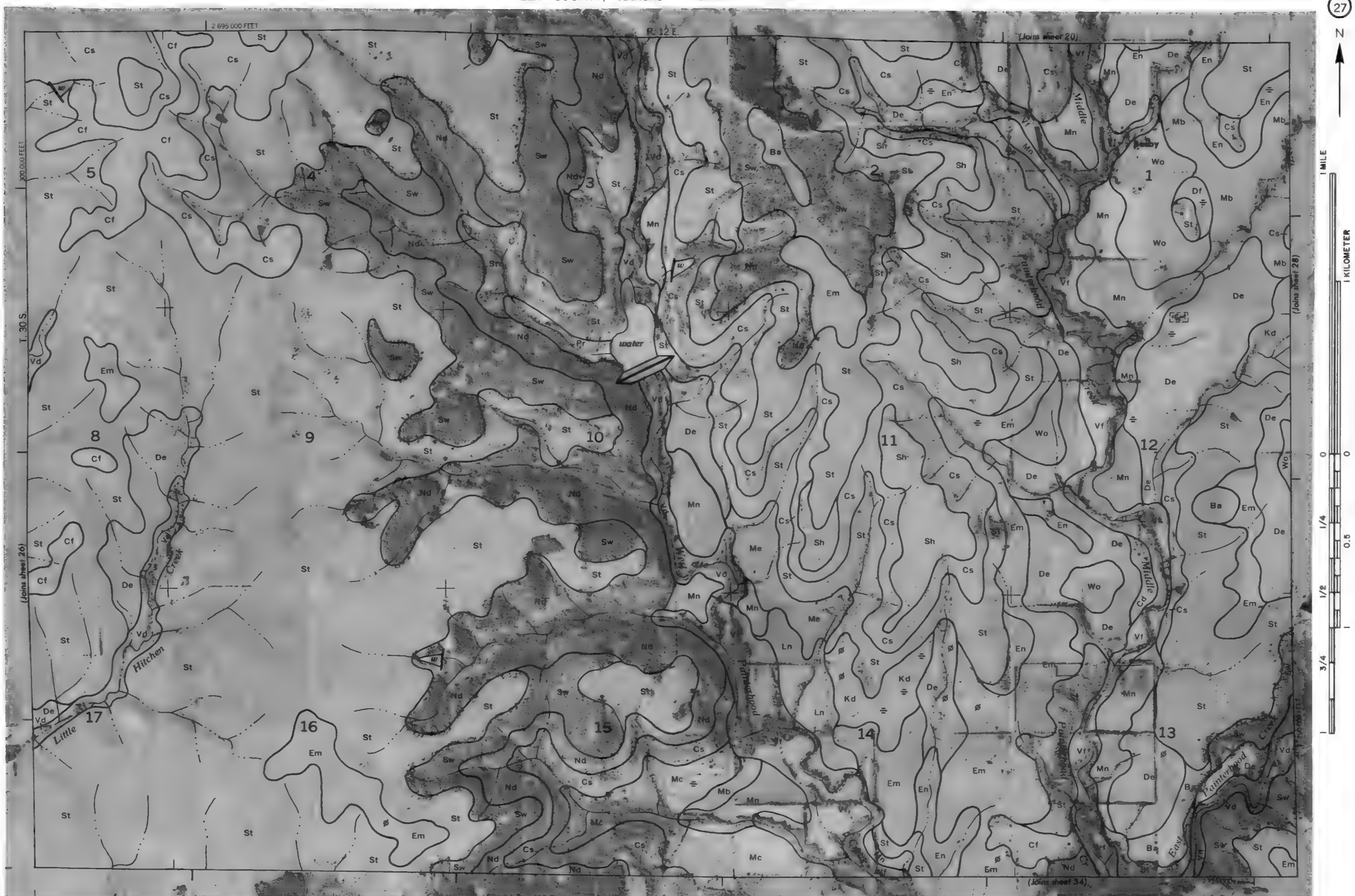


N

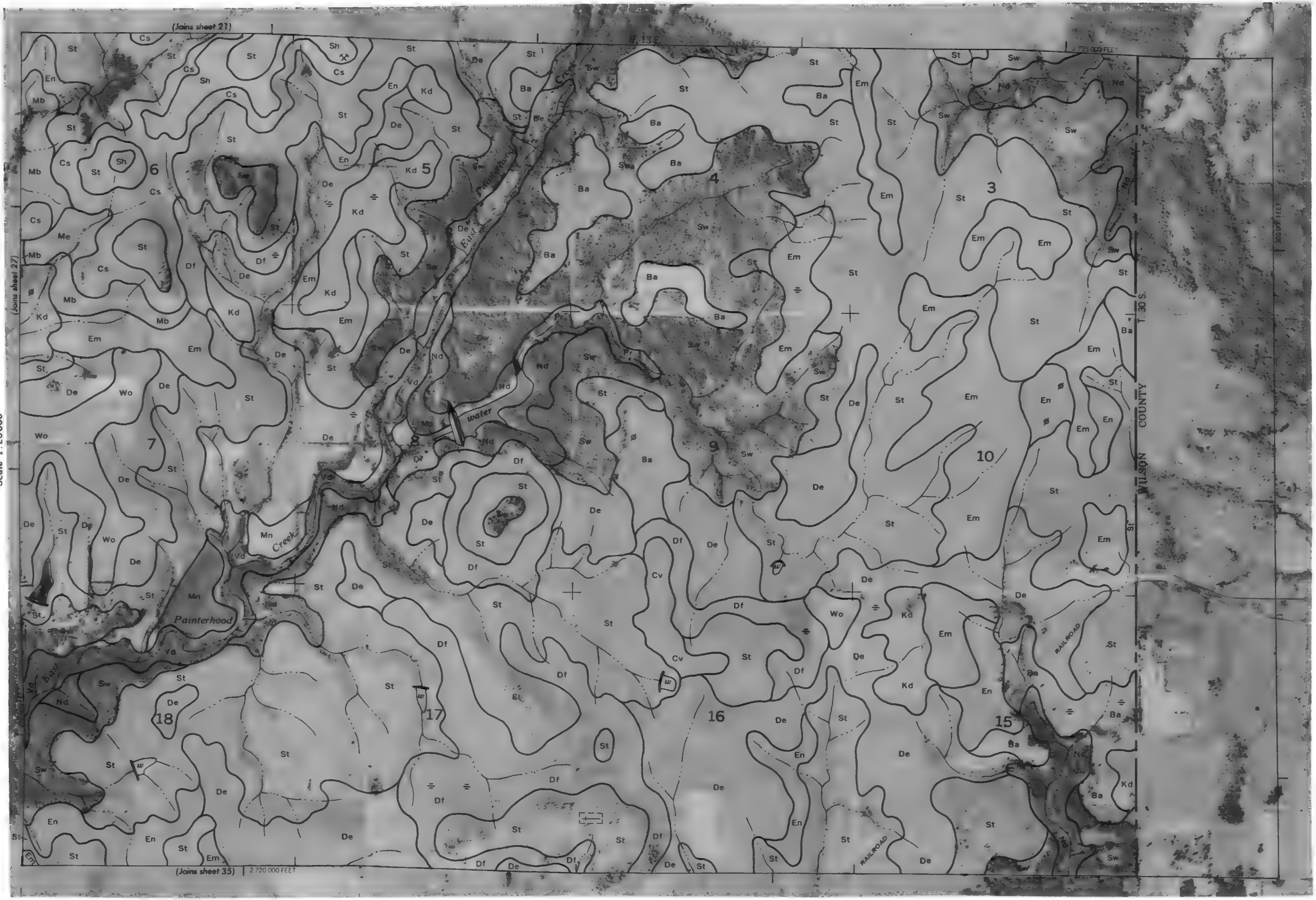
1 MILE

1 KILOMETER

Scale 1:20000

0 1/4 1/2 3/4 1

0 0.5 1



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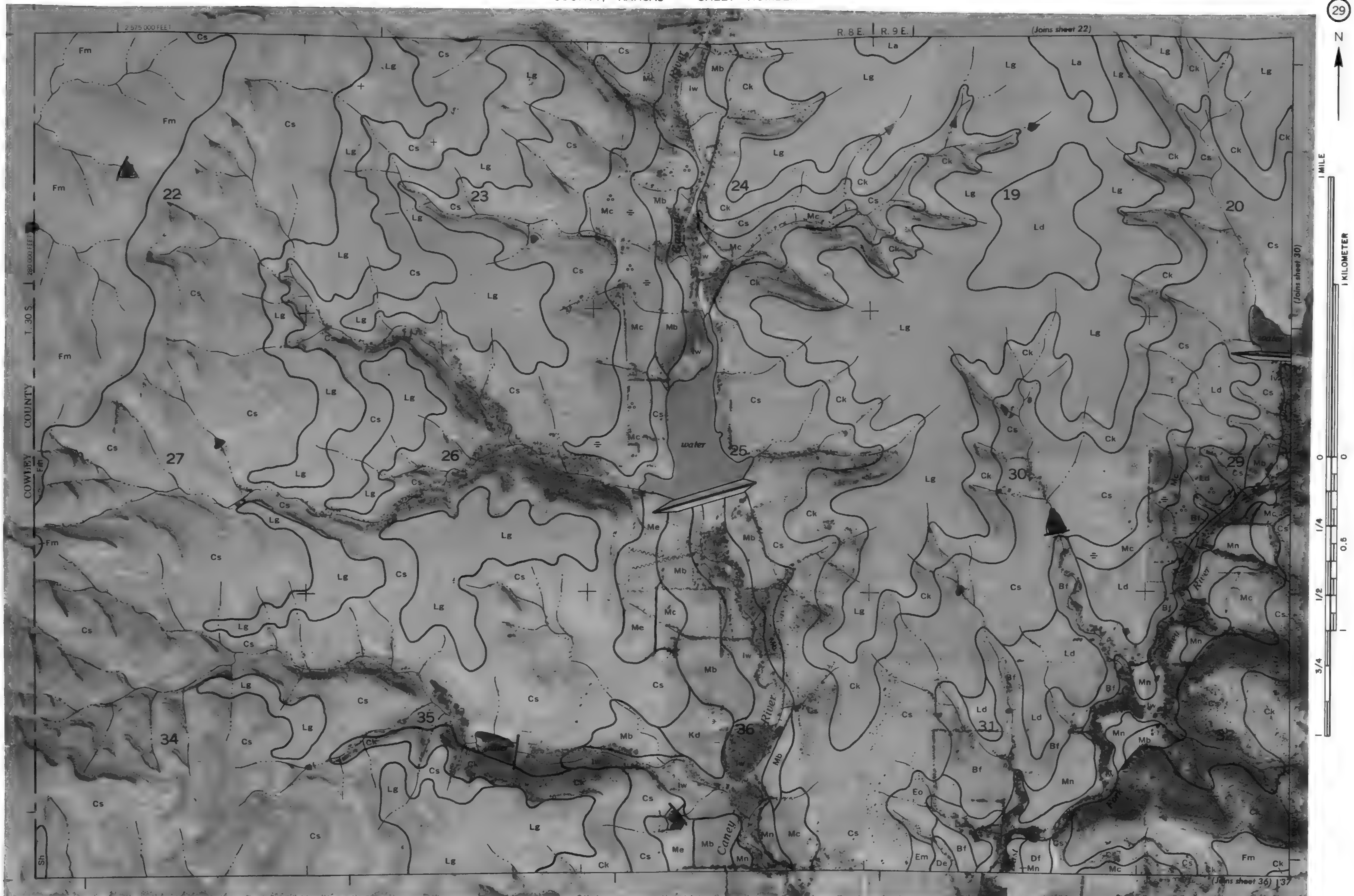
ELK COUNTY, KANSAS — SHEET NUMBER 29



ELK COUNTY, KANSAS NO. 29

This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
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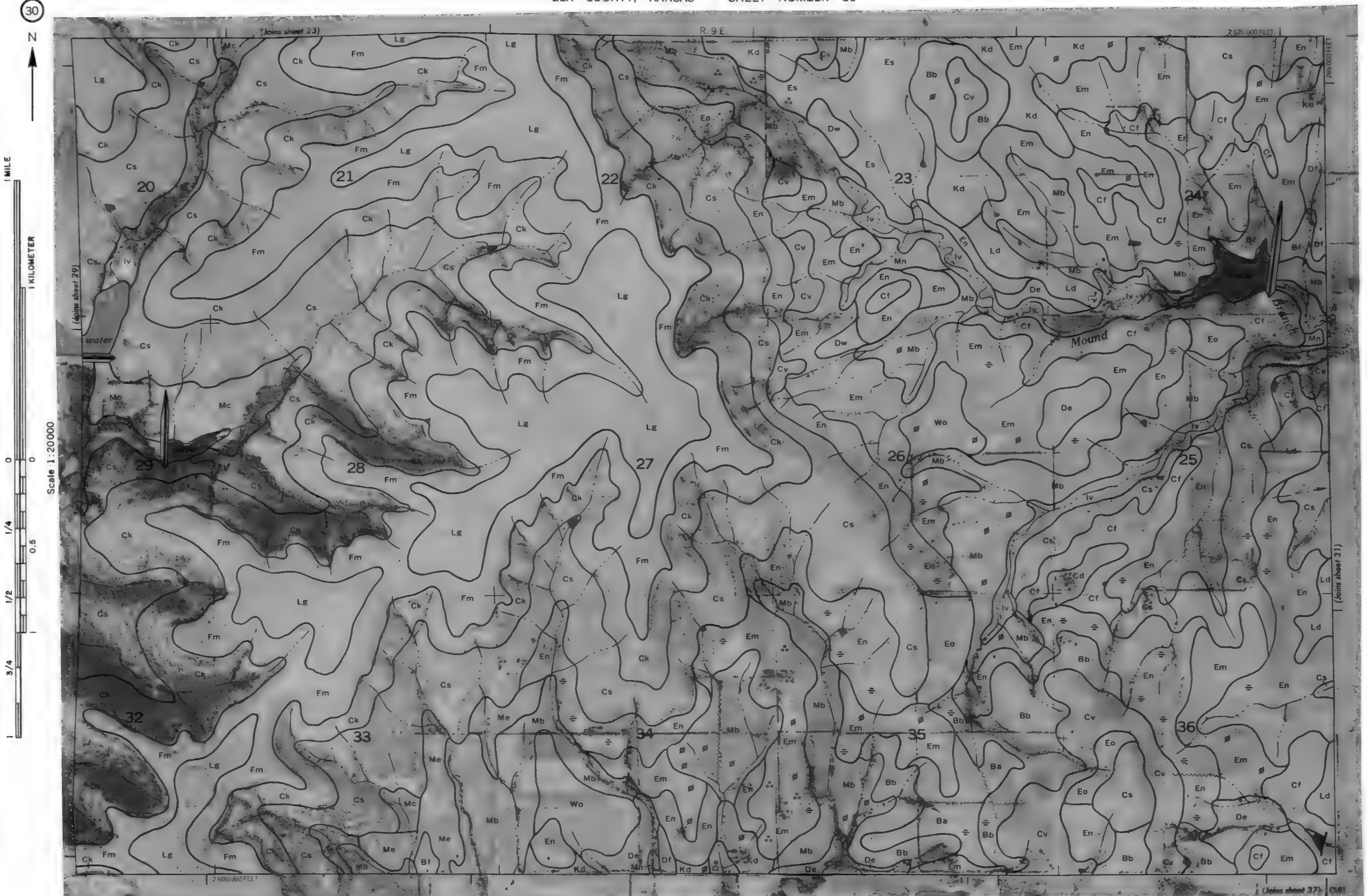
ELK COUNTY, KANSAS — SHEET NUMBER 30



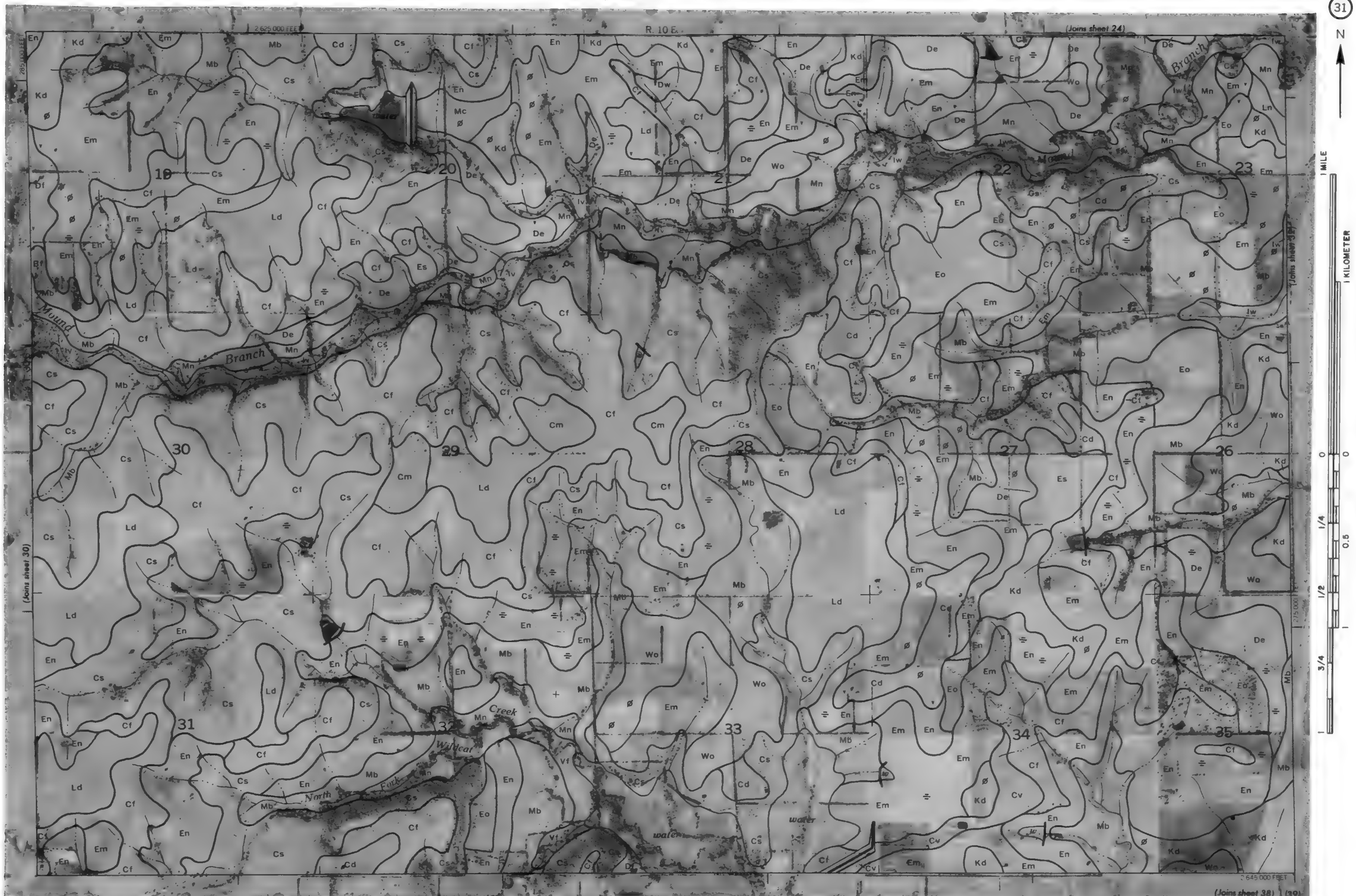
This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

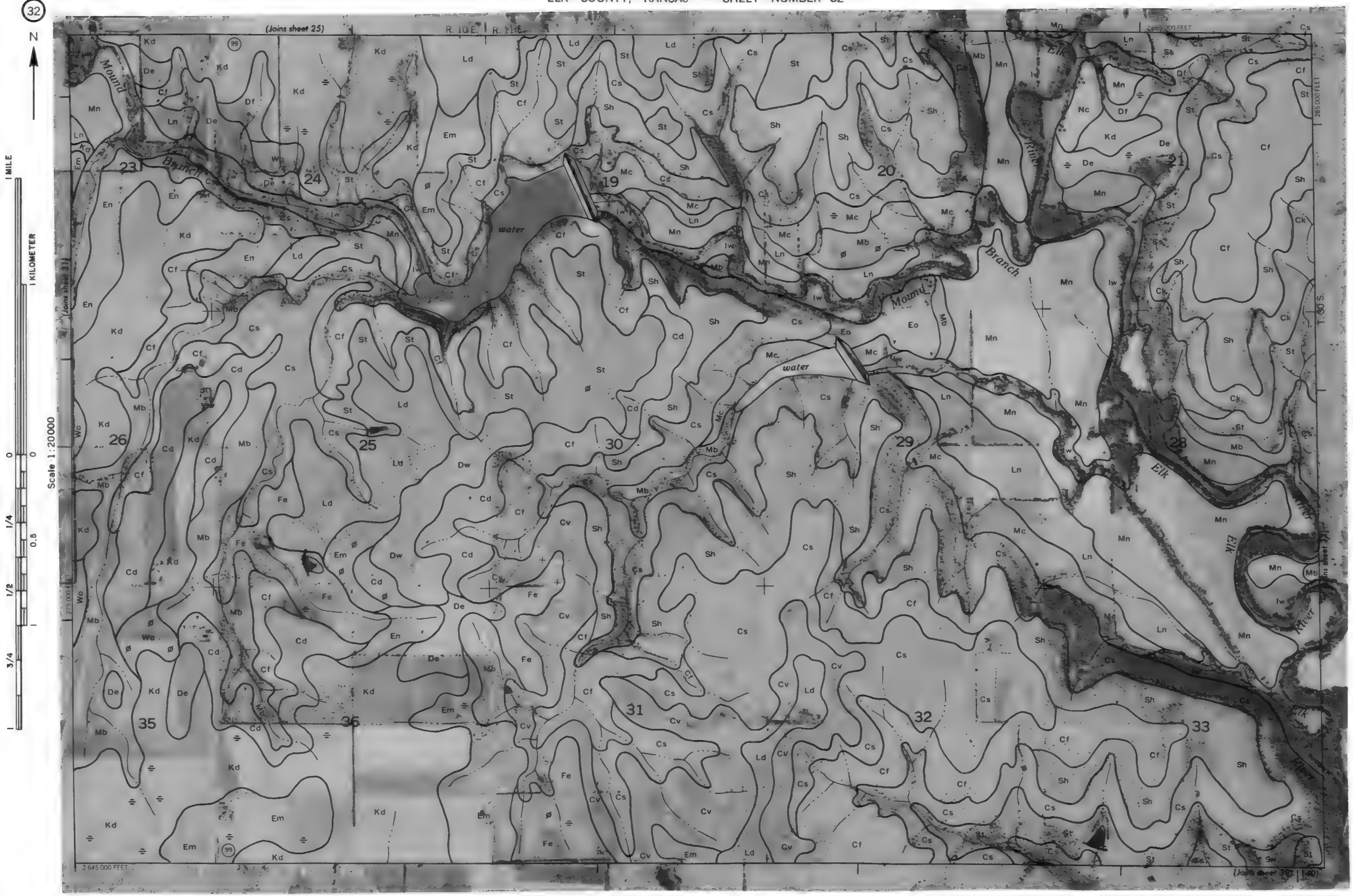
ELK COUNTY, KANSAS NO. 30

(31)

ELK COUNTY, KANSAS NO. 31

This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ELK COUNTY, KANSAS NO. 32

ELK COUNTY, KANSAS NO. 33

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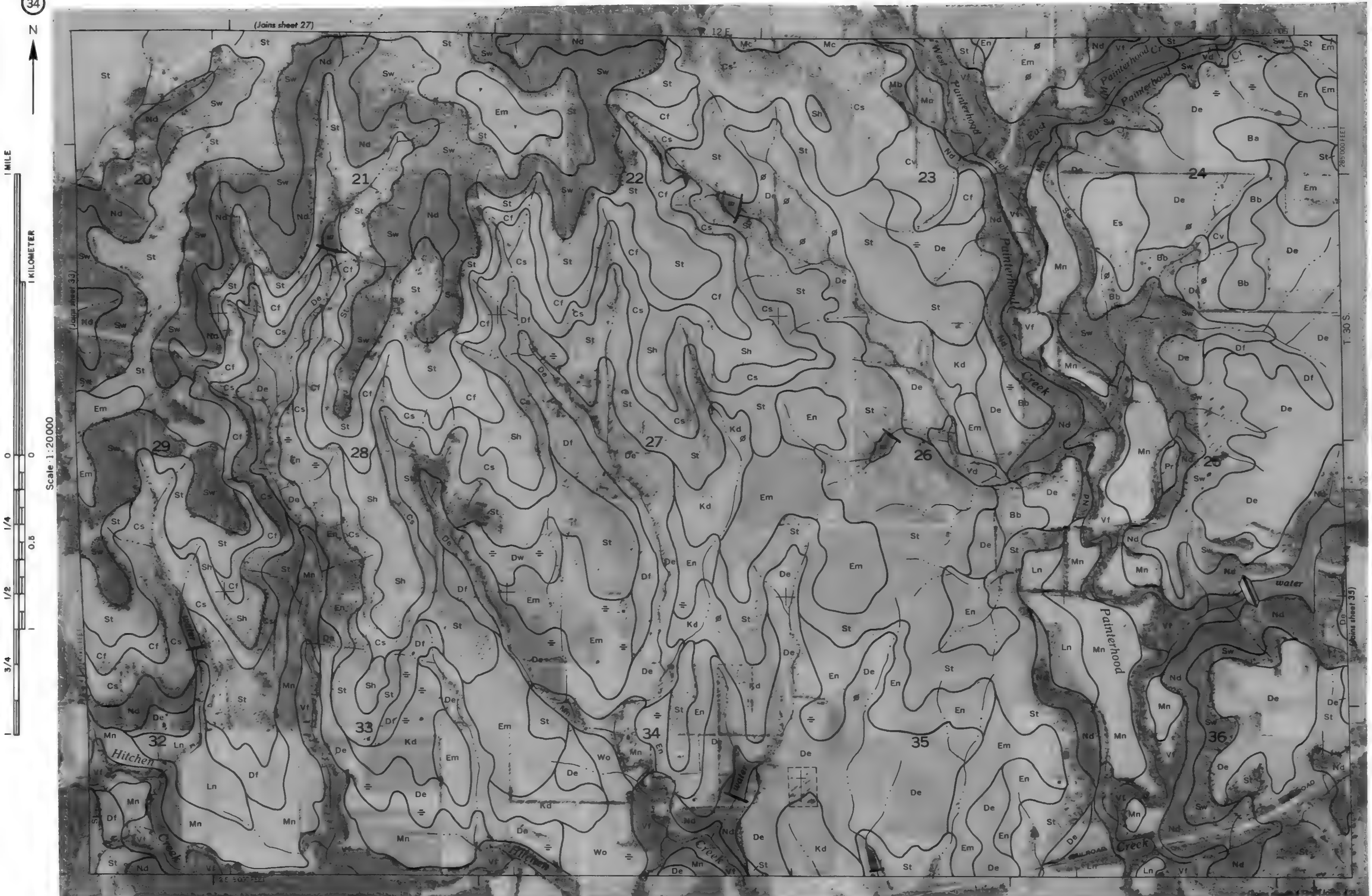

This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ELK COUNTY, KANSAS NO. 34

ELK COUNTY, KANSAS NO. 35

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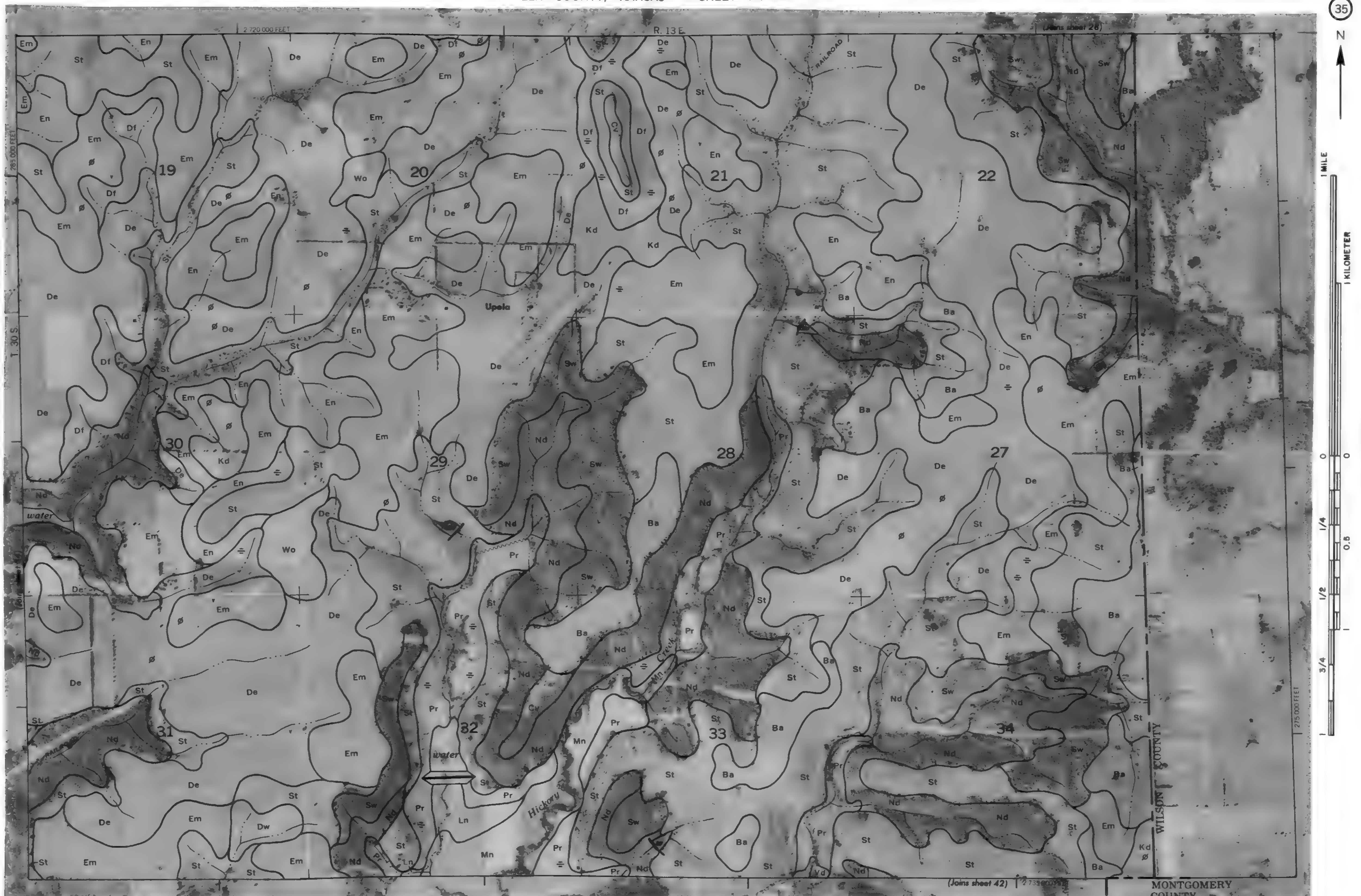
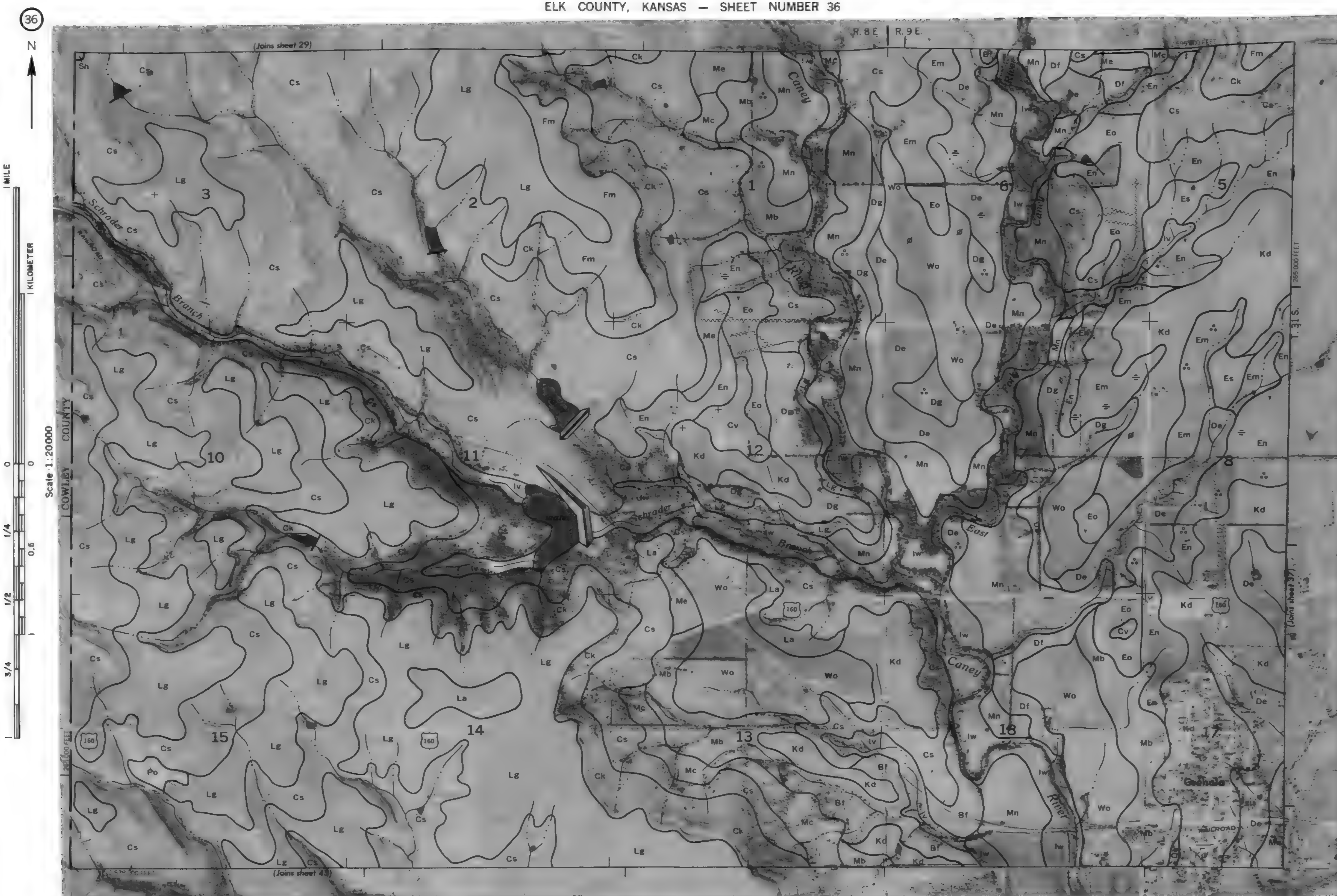




This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

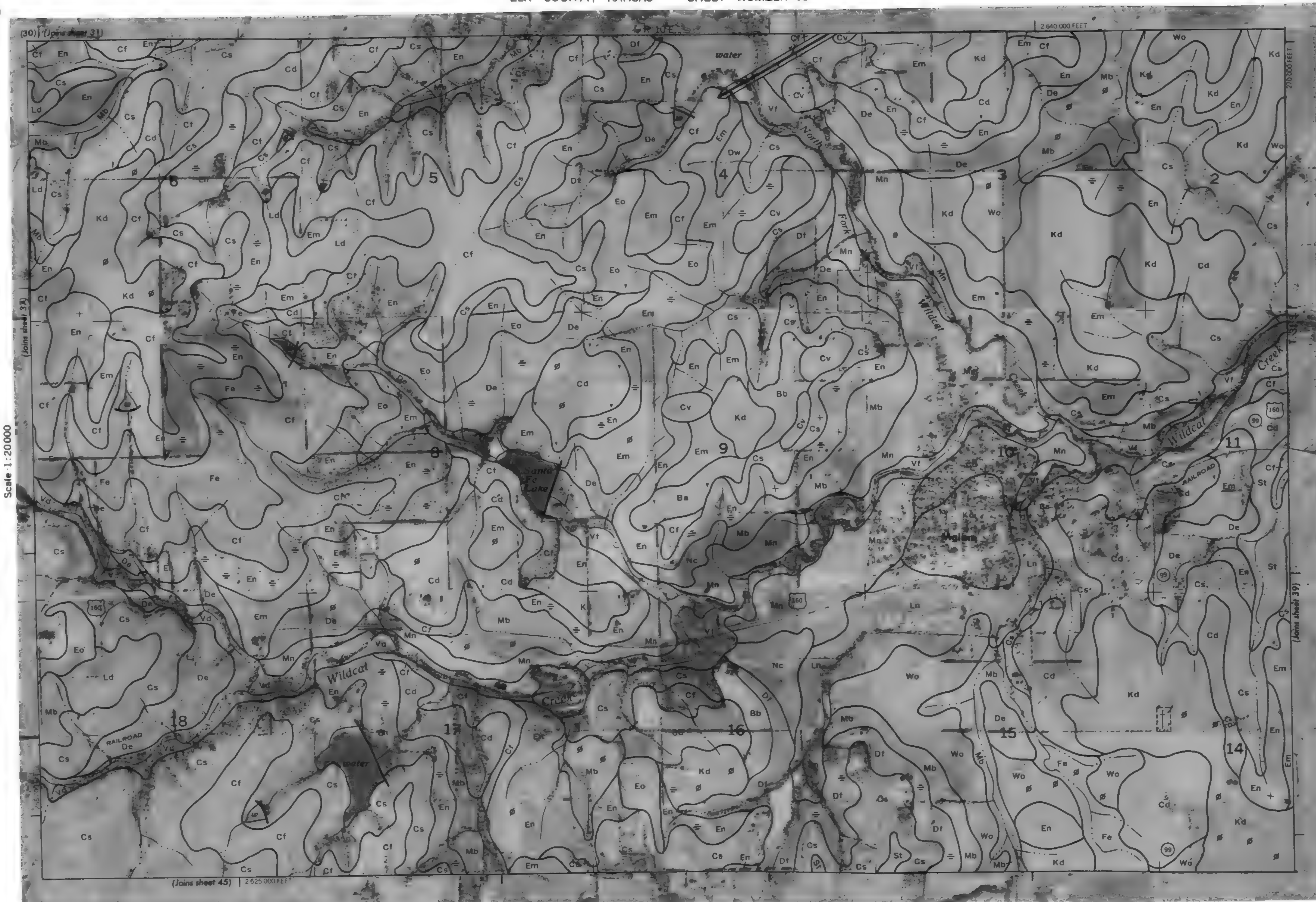
ELK COUNTY, KANSAS NO. 36

ELK COUNTY, KANSAS NO. 37

This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ELK COUNTY, KANSAS — SHEET NUMBER 38

N



1 MILE

1 KILOMETER

Scale 1:20000

0 1/4 1/2 3/4 1

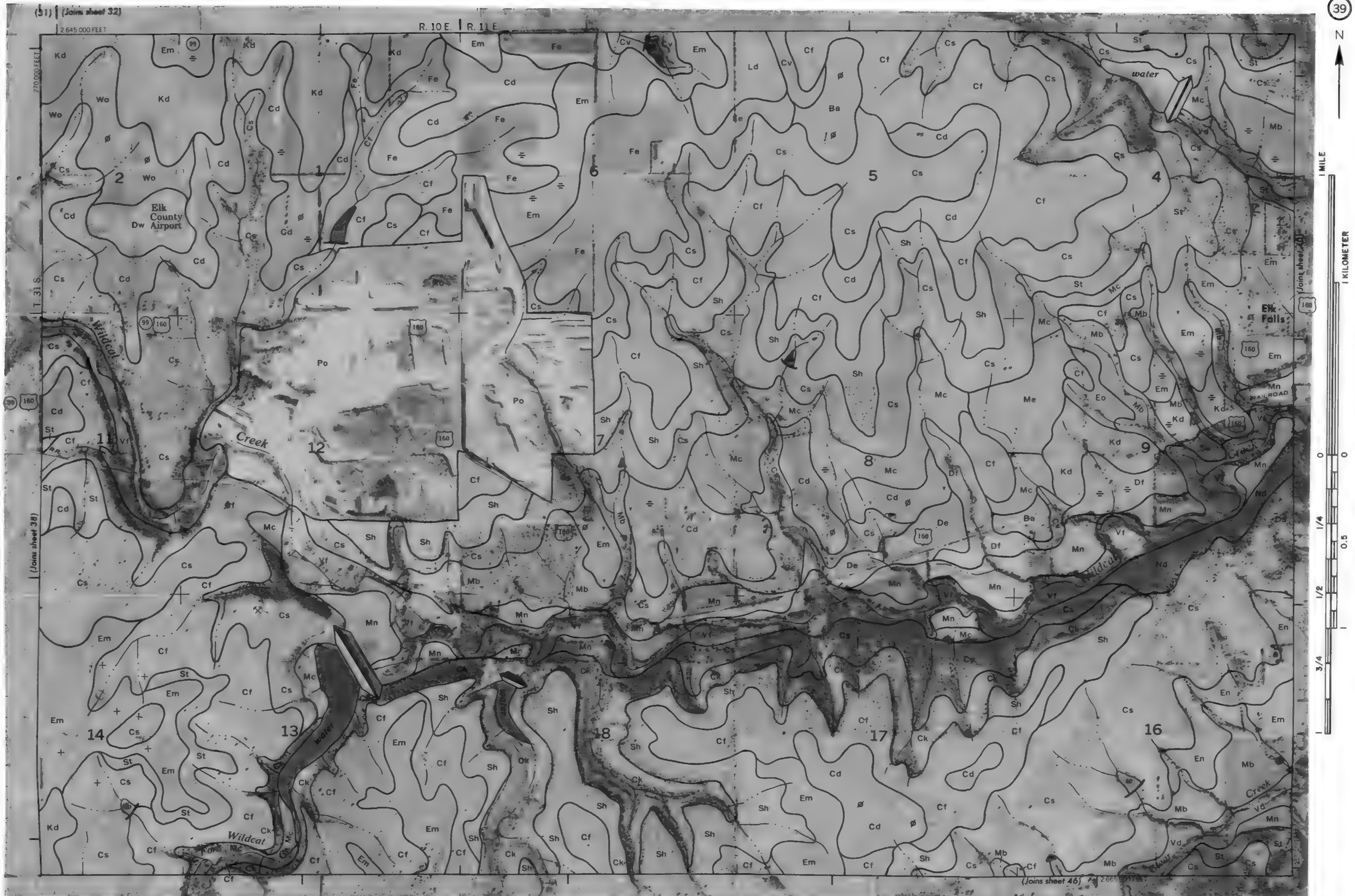
0 0.5 1

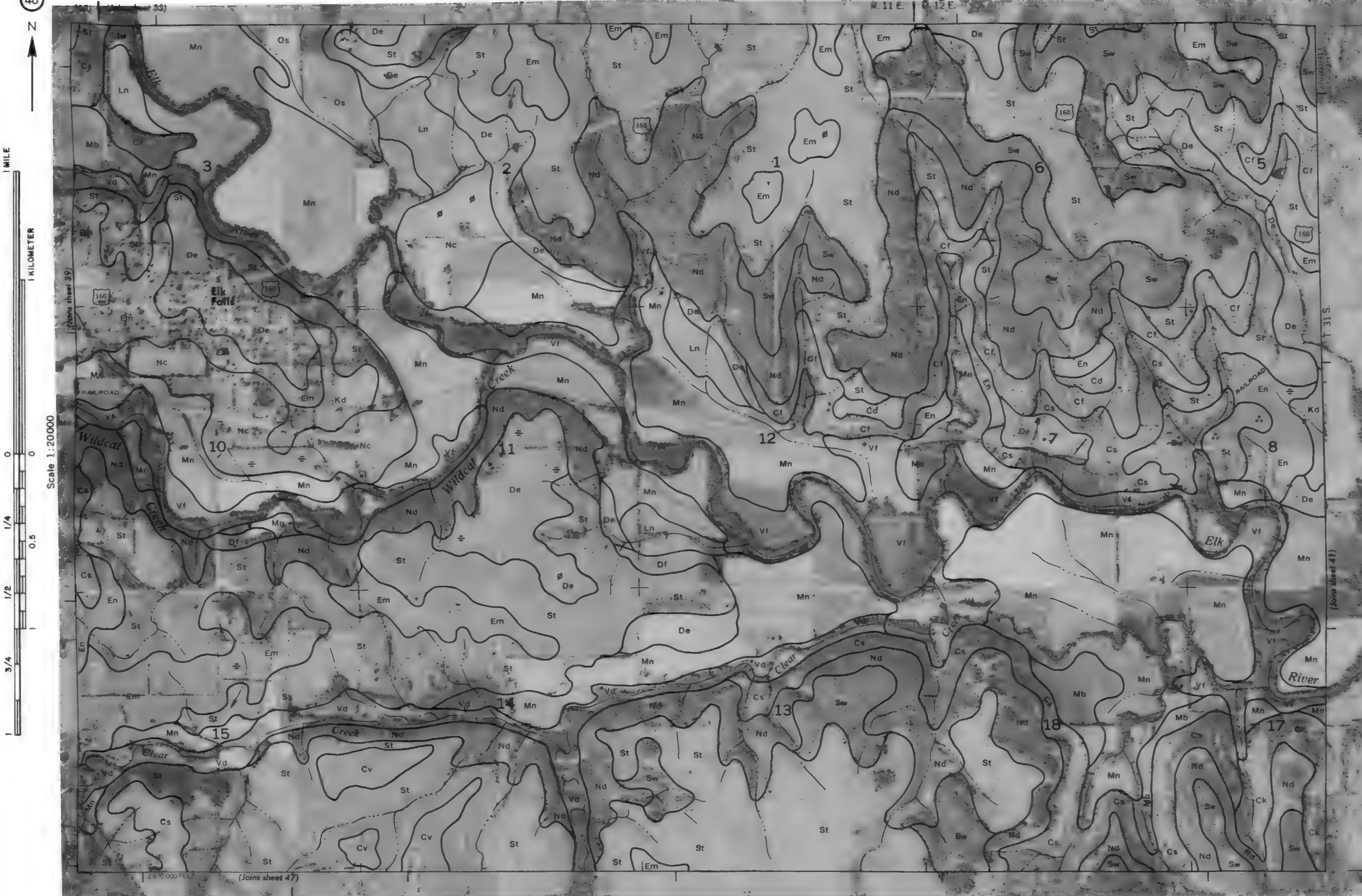
This map is compiled on 1979 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ELK COUNTY, KANSAS NO. 38

ELK COUNTY, KANSAS NO. 39

This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





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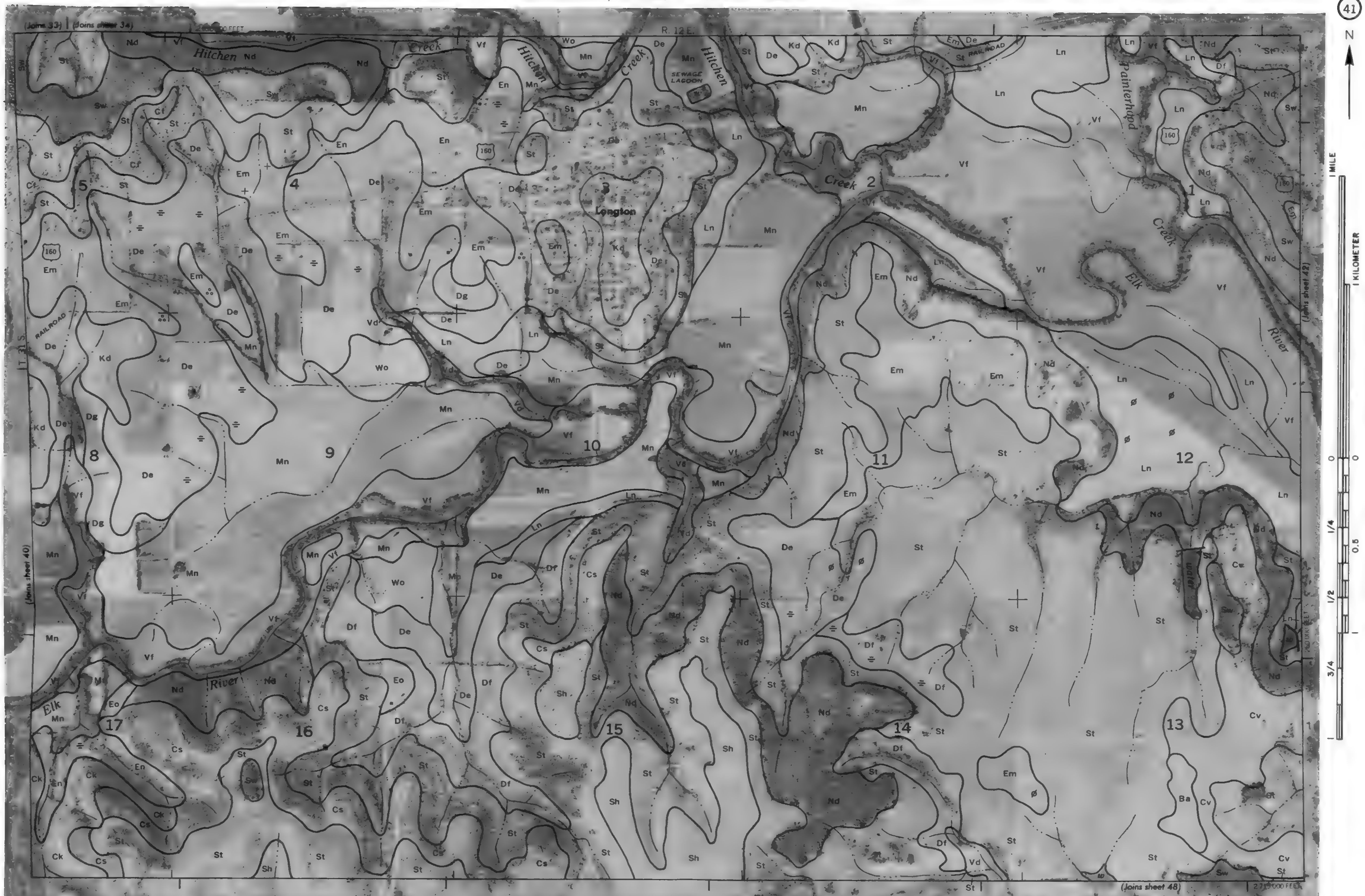
ELK COUNTY, KANSAS NO. 40

41



ELK COUNTY, KANSAS NO. 41

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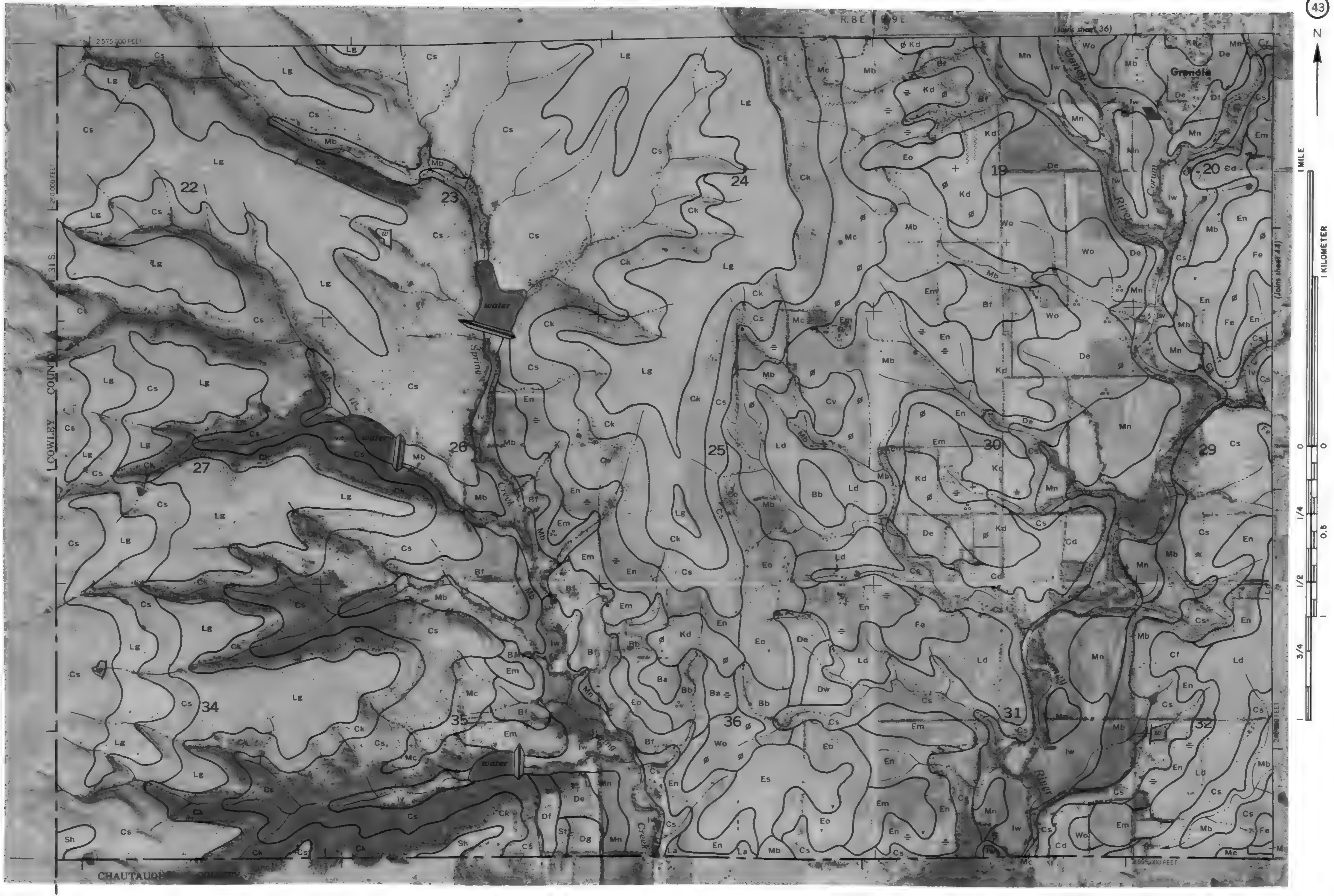
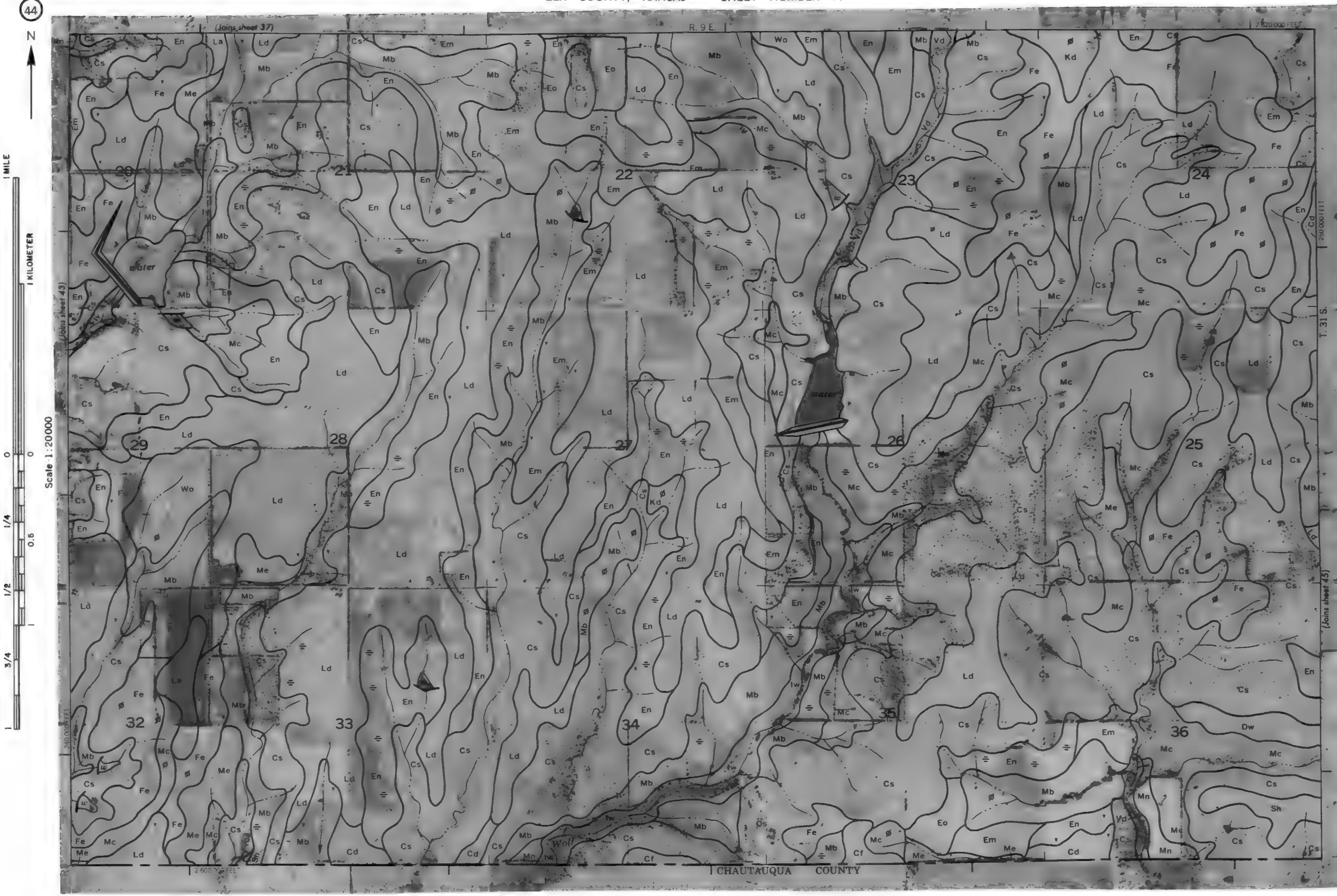
ELK COUNTY, KANSAS NO. 42

ELK COUNTY, KANSAS NO. 43

This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





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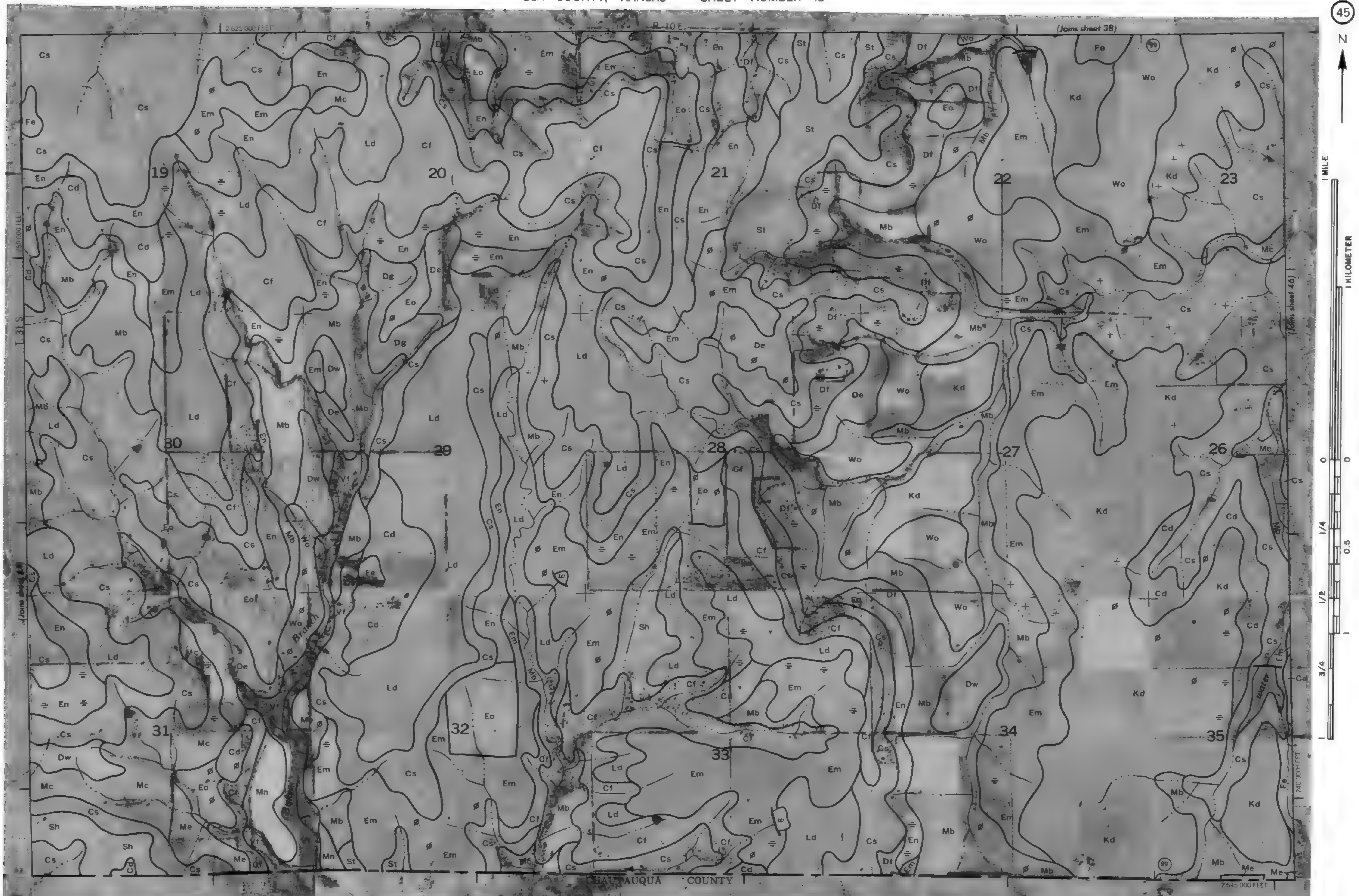
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ELK COUNTY, KANSAS NO. 44

ELK COUNTY, KANSAS NO. 45

This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

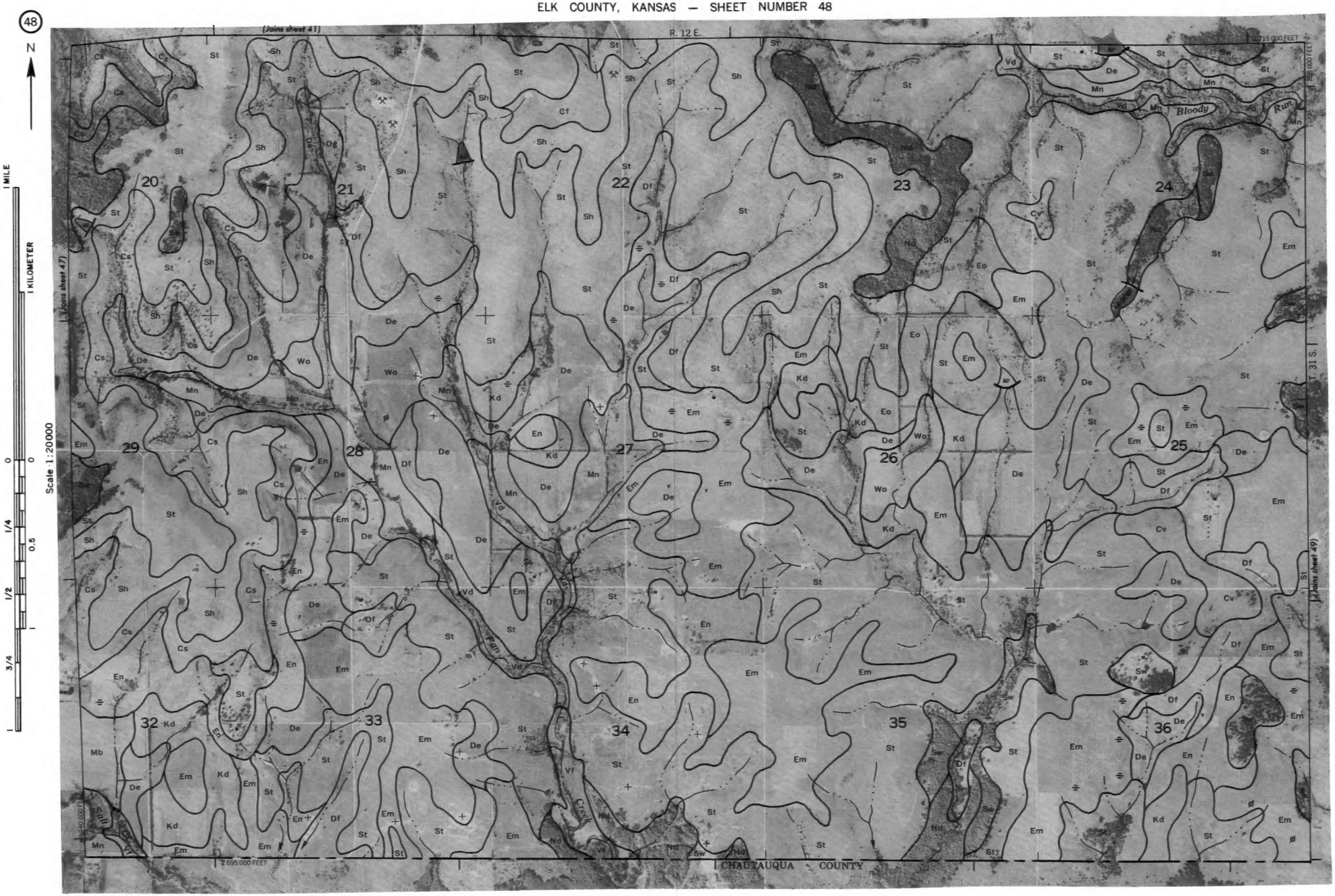


This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ELK COUNTY, KANSAS NO. 46

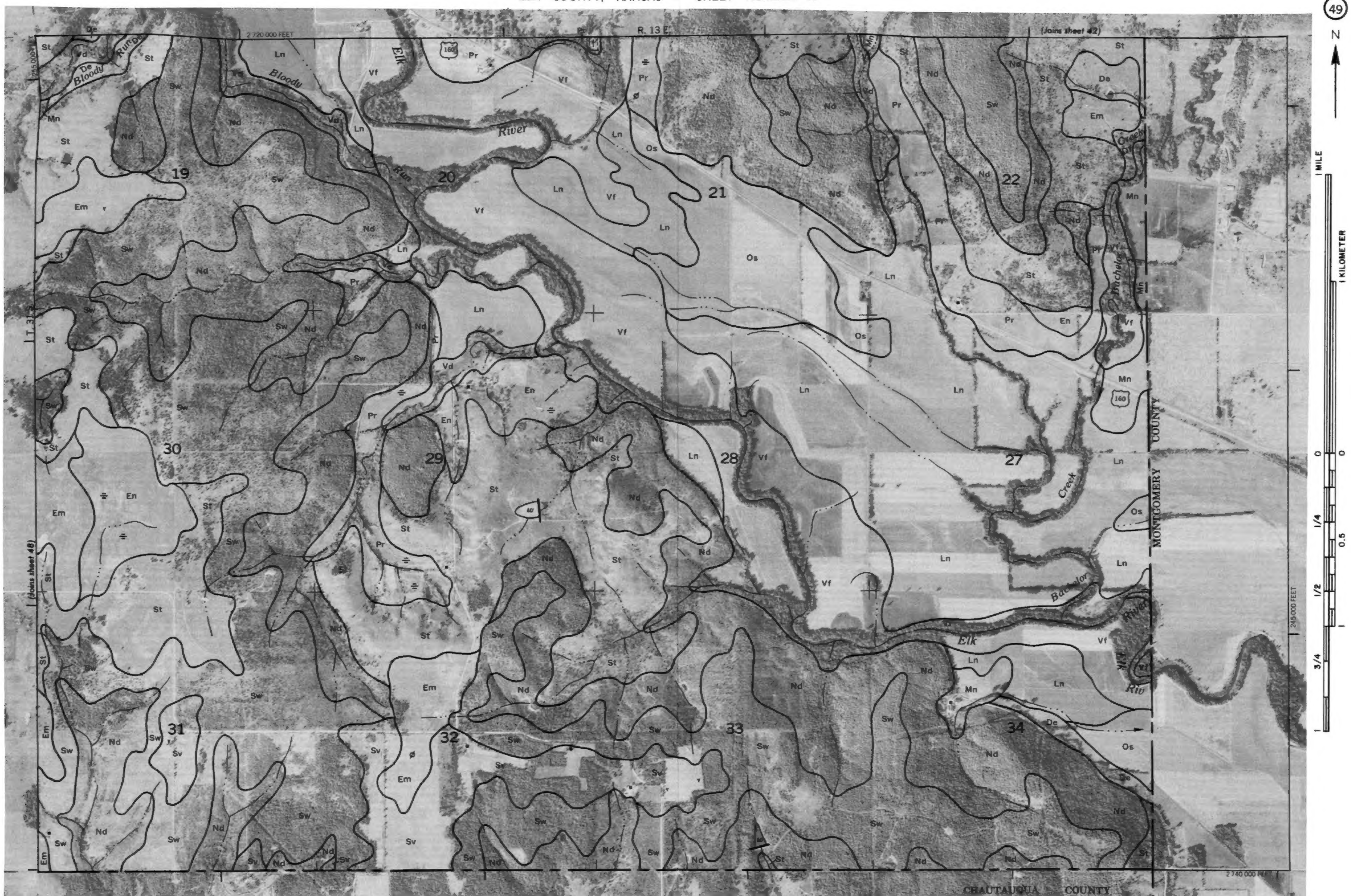
ELK COUNTY, KANSAS NO. 47

This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ELK COUNTY, KANSAS NO. 48



ELK COUNTY, KANSAS NO. 49

This map is compiled on 1978 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.